

EDISON ELECTRIC INSTITUTE

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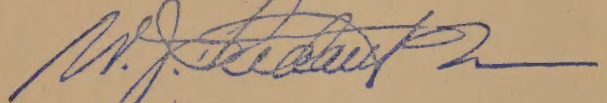
March 2, 1950

To Persons Attending Joint Committee on Electric
Service to Farmers Meeting, February 20, 1950
Chicago, Illinois

Enclosed is a copy of "Farm Electrification Research and
Special Studies Conducted or Contributed to by Electric Operating
Companies since January 1, 1947."

We hope you will find this information valuable to you.

Sincerely yours



W J Ridout, Jr
Rural Service Manager

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FOREWORD

The members of the Farm Section of the Edison Electric Institute wish to express their sincere appreciation to the electric operating companies and the colleges for providing us with information that made this report possible. Every company did not report and therefore we cannot say that this compilation includes all farm electrification research or special study projects that have been conducted since January 1, 1947, by electric operating companies, or jointly with colleges, experiment stations, U S Department of Agriculture, or individual farmers. We expect to revise this report every year and it is hoped that the first revision will be all-inclusive.

Every project reported herein was either conducted, or will be conducted, by the electric operating companies or the electric operating companies have contributed funds to make the work possible. Most of the joint projects are under the supervision of the land-grant colleges. The U S Department of Agriculture has also cooperated on many of the projects. We have given proper credit for every project as far as possible. There is one exception -- wherever the project was under the supervision of a Committee on the Relation of Electricity to Agriculture we have, in most cases, omitted the companies and state and federal agencies cooperating because we felt that the organization of the CREA groups was well understood.

This report has been prepared as a reference for anyone desiring to use it. We have not attempted to give all the details regarding the individual projects. If further information is desired regarding any one project, we suggest that contact be made with the company or supervisory group in charge of the work.

BACTERICIDAL LAMPS IN LAYING HOUSES

1. INDIANA -- Use of bactericidal lamps in laying houses.

This project will be conducted at Purdue University in cooperation with USDA. Funds will be provided by the Indiana Electric Association and supplemented by State and Federal funds. The project will be started on the new poultry farm in cooperation with the Poultry Department.

BARN CLEANERS

1. ILLINOIS -- Illinois Northern Utilities Company reports a minor project in cooperation with the University of Illinois. The project has not been completed.

2. NEW YORK -- The New York Farm Electrification Council has made a very thorough study of the barn cleaner and its advantages for the dairy farmer. A study was made in 1947 and it was concluded that most installations pay the owner a cash saving over and above all costs. The Council will continue to inform the farmers of New York State concerning this reasonably new application of electricity on the farm.

BROODING OF CHICKS

1. CONNECTICUT -- The Connecticut Light and Power Company is now making a study on a practical poultry farm to compare the overall merits of brooding using either manufactured gas or electricity, including the effects on wet litter problems. Some information on this project should be available in 1950.

BROODING OF CHICKS (Continued)

2. MICHIGAN -- The Detroit Edison Company is planning a study to compare the use of infra-red heat lamps without a hover to the use of hover type brooders. They are interested in operating costs.

3. NORTH CAROLINA -- Nantahala Power Company makes the following report on a project using soil heating cable under the litter as a source of heat: This cable has been used for brooding chicks three times so far. Twice, sand was used for litter and once we used cotton seed hulls. With the exception of a higher current consumption per brooded chick the results have been excellent. No supplemental heat was used, though we were prepared to use one or two infra-red bulbs suspended from the ceiling if the temperature in the house dropped too low. In the experiments we used 3-120 ft lengths of lead covered cable in a 12 x 14 brooder house. The cable was placed on top of the concrete floor and spaced 4 to 6 inches apart and covered with 1/2 to 1 inch of litter. The thermostat was placed about 6 inches off the floor. For the first two weeks the temperature ranged from 70 to 78 degrees with no apparent discomfort to the chicks. The first brood was started January 15th. Current consumption through the brooding period was 1500 kwhr. During this period the outside temperature ranged from 16° to 65° with an average of probably 45° to 50°. The second brood (in another house) was started about April 1st with a current consumption of 1,000 kwhr for the brooding period. During the early part of this period we had considerable sub-freezing weather. The third brood was started April 20th with a current consumption of only 275 kwhr for the brooding period.

The chicks remained lively throughout the brooding periods, feathered well and grew very fast. The main advantages seem to be a

BROODING OF CHICKS (Continued)

dry litter at all times, practically no crowding or packing of chicks, low mortality (less than 2% so far) and the farmers particularly liked the advantage of seeing all the chicks as soon as he opened the door without having to raise the hover of a conventional brooder. Though the chicks will scratch the litter off of sections of the cable from time to time, the exposed cable does not seem to create any cause for concern.

We would like to try this type of brooding some more before recommending it for general use, but we believe it will prove practical for poultrymen raising from 300 to 500 chicks in areas where brooding could be done at a cost of from 1 to 1-1/2¢ per kwhr.

4. WEST VIRGINIA -- Monongahela Power Company in cooperation with West Virginia University is planning an electric brooding project, details of which are now being worked out. The objective was not reported.

5. WISCONSIN -- At the University of Wisconsin Research farm in cooperation with Wisconsin Utilities Association, tests are being conducted on the use of infra-red lamps for brooding chicks without hovers. Here the chicks were brooded under infra-red heat lamps equipped with metal shades of about 14" diameter to protect the lamps from breakage. The usual hover or cover over the chicks was dispensed with. The mortality of chicks was as low as it might be by any other method of brooding and electricity costs per chick were lower than they were when the conventional electric brooder was used. What is more important is that the equipment necessary for this type of brooding is simple and inexpensive; as a result more farmers will buy and use it.

BROODING OF CHICKS (Continued)

6. LOUISIANA -- Louisiana Power & Light Company in cooperation with Louisiana State University Experimental Station at Caljoun, Louisiana, obtained the following results from the study of an eight-week cost study on electric brooding compared with oil.

Results of Chicken Brooding Studies for an 8-Week Period

I. Brooding with electricity

Number chicks brooded	187	-	187
Mortality	1.07%	-	1.07%
Electricity Used	293 kwhr	-	293 kwhr
Electric consumption per chick	1.56 kwhr	-	1.56 kwhr
Cost per chick	3.5¢	-	3.5¢

II. Total cost of electricity for brooder house

Electric lights in brooder house, sun lamps, germicidal lamps and electric brooder

Total electric consumption	390 kwhr	-	390 kwhr
Electric consumption per chick	2.1 kwhr	-	2.1 kwhr
Cost per chick	4.6¢	-	4.6¢

III. Comparison of costs of brooding by using electricity and oil

	<u>Oil</u>	<u>Electricity</u>
1. Chicks brooded	178	187
2. Mortality	1.12%	1.07%
3. Cost of fuel per chick (labor cost not included in fuel cost)	7.6¢	3.5¢
4. Cost of brooding 100 chicks	\$7.60	\$3.50

CALF DEHORNING

1. WISCONSIN -- At the University of Wisconsin Research Farm in cooperation with the Wisconsin Utilities Association, tests are being run on the use of an electrically heated calf dehorning iron. In the near future, information will be released comparing this method with that of cutting tools or caustic solutions.

CHEMURGY

1. IDAHO -- Idaho Power Company is running tests on the production of safflower as another crop that can be produced on dry land. Safflower is a source of dye and drugs. Canadian hybrid sunflower also is being test grown. Sunflower seeds are a source of vegetable oil.

2. IDAHO -- Development of potato starch and potato pulp from Irish potatoes. Idaho Power Company has been largely responsible for the development of these by-products for farmers in their territory.

CHEESE CURING

1. IDAHO -- Effect of ultra-violet light in controlling mold on cheese. This was a CREA project in Idaho. The study concluded that mold growth can be controlled by using ultra-violet lamps. However, the lamps lost two-thirds of their efficiency during the 1776 hours of the test. The ultra-violet lamps will not irradiate the air and control bacterial growth by air irradiation alone.

CORN BREEDING

1. GEORGIA -- The Georgia Power Company cooperated with the Georgia Experiment Station in the development of the breeding of hybrid corn suitable for Georgia farms from 1944 to 1948. The Company is now offering incentives to 4-H Club members to raise better hybrid corn.

2. GEORGIA -- Development of a better roasting ear. The Georgia Power Company has a continuing project in cooperation with 4-H Club members, veteran trainees, and adult farmers to develop better quality roasting ears for market.

COW TRAINERS

1. WISCONSIN -- This project is being conducted at the University of Wisconsin Research Farm in cooperation with the Wisconsin Utilities Association. For years the little Jersey cow and the large Holstein cow stood in concrete decked stalls of the same length. Too long for the little cow and too short for the large cow was the general result. Udder injuries, mastitis, garget and difficulty in keeping the cows clean were the shortcomings of these stalls. At the Research Farm it was observed that all cows hunch their backs before dropping litter. This observation led to the arrangement where a coat hanger shaped wire frame energized with a fence charger was suspended over the cow's back slightly rearward from her front shoulders. The result is that it is possible to use long stall floors preventing udder injuries and still keep the cow clean because the cow trainer centers her over the gutter where all the litter goes now. Cleaner barns, healthier cows, and less work for the farmer is what all of this adds up to.

DAIRY BARN VENTILATION

1. ILLINOIS -- Illinois Northern Utilities Company reports they have a cooperative project in process of completion with the University of Illinois.
2. MAINE -- The University of Maine and the electric operating companies serving the state are cooperating on a dairy barn ventilation project. No details were reported.
3. MINNESOTA -- North East Minnesota Farm Electric Council - Minnesota Power & Light Company is a member of this group. They made two special studies. The following are the results of these two studies.

Chris Hansen Farm - Grand Rapids, Minnesota

Dairy-Barn - 65' x 16' -- Lean-to shed type, Frame construction; shavings for insulation; housing 16 good cows.

Equipment Installed - 12" aerovent Fan with automatic shutters and with temperature control. 10" x 20" duct from fan down to within 16" from barn floor. Four air intakes (4" x 15") taking air down from the hayloft.

Cost of installation --

Fan, Motor, Shutter, Airstat	\$73.50
Estimated cost of materials	30.00
Total	<u>\$103.50</u>

Operating Cost of System

Days in operation --

(Dec 17; Jan 31; Feb 28; Mar 31)	107
Total kwhr used	152
Average kwhr per day	1.42
Cost of 152 kwhr at 4-1/2¢	\$6.84
Interest on investment	<u>1.04</u>

Total operating cost 3½ months \$7.88

Average cost per day 7-1/3¢

DAIRY BARN VENTILATION (Continued)Summary of Temperature and Humidity Data by Months

	<u>December</u>	<u>January</u>	<u>February</u>	<u>March</u>	<u>Average (4 Months)</u>
Average Outside Temperature	- 3.2F	- .77F	- 7.4F	+7.1F	- 1.07F
Average Inside Temperature	52.9F	54.4F	53.4F	55.4F	53.3F
Highest Temperature - Outside	+20F	+25F	+22F	+30F	+24.25F
Inside	+60F	+60F	+58F	+64F	+60.5 F
Lowest Temperature - Outside	-34F	-30F	-45F	-20F	-30.25F
Inside	+46F	+46F	+45F	+52F	+47.25F
Average Relative Humidity	71.3%	68.3%	69.5%	62%	68%
Low Relative Humidity	69%	64%	67%	58%	64.5%
High Relative Humidity	75%	75%	73%	69%	73%

Based on this study, you can see that an electric dairy barn ventilation system has done an effective job under very difficult conditions. I hope you will notice the -45° F temperature on February 2nd and the lowest inside temperature of +45° F for the same day. The relative humidity in this dairy barn also held very uniform and near the ideal point.

4. MINNESOTA -- Northern States Power Company will make studies in barn ventilation this coming winter.

5. NEW YORK -- The work of the New York Farm Electrification Council regarding this project has been quite extensive. The electric operating companies have contributed to this project through the council. No attempt will be made here to summarize the work that has been done so far. For detailed information write the New York Farm Electrification Council at Cornell University.

DAIRY BARN VENTILATION (Continued)

6. PENNSYLVANIA -- West Penn Power Company and Penn State College cooperating. Study of the various factors which are necessary for a successful dairy stable ventilation installation such as, fan location, amount of air, type and location of fan control, and type of inlet. Data has been collected during the 1947-1948 and 1948-1949 animal housing period, but definite conclusions cannot yet be drawn. This work will continue during the coming winter.

7. VERMONT -- Central Vermont Public Service Company after 10 years of study was able to announce a complete packaged unit dairy stable ventilator. This ventilator is now being produced commercially. As a complete package unit it is very materially changing the application of forced draft ventilation to dairy stables.

8. OREGON -- This is a cooperative project between Oregon State College and the Agricultural Engineering Research Foundation. The budget of the Agricultural Engineering Research Foundation is made up from contributions by the power companies of the state. The purpose of this study was to develop general specifications for the ventilation of dairy barns located in the Willamette Valley. This work was started during the winter of 1948-1949 and our results indicate that much larger quantities of air were necessary if odors and ammonia fumes were to be controlled and kept down to a satisfactory level. Exchange rates of 120 cubic feet per minute per cow appeared to be adequate for odor control.

DAIRY WATER HEATING

1. PENNSYLVANIA -- West Penn Power Company and Penn State College cooperating. Study of the needs for hot water in wholesale dairy farming including the quantities and the time of these needs. Study completed during winter of 1947-1948. The results which include an electric water heater sizing chart were published in a bulletin, "Planned Electric Water Heating."

2. MICHIGAN -- The Detroit Edison Company has made a study of the use of a six gallon pressure type water heater in a milk house. No details reported.

DEMONSTRATION FARMS

1. IOWA -- On July 1, 1947, Iowa State College Agricultural Extension Service and the Iowa Utilities began a five-year cooperative program which provided for the setting up of ten rural electric demonstration farms in Iowa. In addition to the extension phase, a research program was added a year later. The objective of these programs was to show how electricity can reduce chore labor, increase or improve production and, in general, show how it can make for better living on the farm. This program is just getting into full swing and at the time of the writing of this report, none of the results obtained so far are available for publication.

2. OHIO -- Ohio Public Service Company reports that they have been conducting tests on one farm in cooperation with Westinghouse Electric Corporation. No details reported.

EFFECT OF NIGHT LIGHTING ON THE GROWTH AND FATTENING OF HOGS

1. INDIANA -- This project is being conducted at Purdue University in cooperation with USDA. Funds are provided by the Indiana Electric Association and supplemented by state and federal funds. This is a cooperative project between the Agricultural Engineering and Animal Husbandry Departments. One feeding trial was completed during the summer of 1949. Two pens of 16 hogs each had light over their feeder all night and two other pens of 16 hogs each did not have light. The hogs were weighed every 2 weeks and the feed consumption checked every two weeks.

In this test when the days were long there was no significant difference in the rate of gain or the feed consumption. Another winter feeding trial is now in progress where the feeders will be placed inside the houses with two pens receiving light and the other two pens having no light. In the winter feeding test recording clocks will be placed on each feeder to determine the time of the day the pigs in each pen feed.

EFFICIENCY STUDIES

1. CALIFORNIA -- Farm efficiency in the use of electricity. This CREA project is authorized but not yet started in California. It will include time and motion studies, investigation of the efficiency of existing installations, and development of better methods and application of electricity to farm operations.

EGG CANDLING

1. CALIFORNIA -- This is a CREA project in California authorized but not yet started. The study is to determine suitable equipment and proper light intensity to do an efficient job of candling eggs.

EGG COOLING

1. CALIFORNIA -- A CREA project. Plans and specifications have been developed. No further details were reported.

EGG ROOM HEATING

1. MAINE -- The University of Maine and the electric operating companies that serve the state are cooperating on this project. No details were reported.

ELECTRONICS

1. CALIFORNIA -- A CREA project. They have a continuing project on electronics making studies on the treatment of agricultural products with radio frequency. The following is quoted from a recent CREA report: "Our high frequency studies may seem to be somewhat negative in their results but this is not entirely so. We heated honey -- perhaps could similarly heat other liquids. Gelders is experimenting with environmental effects and media containing bacteria and Powers has made satisfactory application of electronically operated gates for sizing lemons." (This application has been adopted by the lemon-packing industry.)

ELEVATORS

1. VERMONT -- Development of a platform type elevator for use in farm buildings. Central Vermont Public Service Corporation is working on this project. They have several trial installations in operation now and expect to make an announcement about it in the near future.

FARM BUILDING CONSTRUCTION

1. IDAHO -- Heat losses through a wall section of a farm utility building. This is a CREA project in Idaho to determine the practicability of diatomaceous earth concrete farm utility buildings from an insulation standpoint. An electric heater has been installed in a small 8' x 8' building that has been constructed with slabs of experimental diatomaceous earth concrete. Recording thermometers were installed on the inside and the outside to obtain accurate temperatures. The heat input and power consumption were to be closely checked and temperature variations through the 8" wall sections were to be recorded. Complete information on this project can be obtained from Idaho.

2. MINNESOTA -- Northern States Power Company is making studies of a dairy installation consisting of a complete design, development of two lounging barns, milking parlor and milk house. They recommended the insulation and obtained the assistance of the Western Mineral Products Company in the development of a vermiculite for construction. They reported this was the best kind of insulation they could use.

3. OHIO -- Toledo Edison Company. A project will be started in 1950 in cooperation with Libbey-Owens-Ford and Owens-Corning Glass Company on the construction and study of a poultry house.

FARM FREEZERS

1. PENNSYLVANIA -- The Philadelphia Electric Company reports a farm freezer test covering a three-year period checking temperature, kwhr use, sweating conditions, defrosting, together with all types and conditions of food both cooked and uncooked. No further details were reported.

FARM FREEZERS (Continued)

2. LOUISIANA -- Louisiana Power & Light Company completed a one-year test on kilowatthour consumption on two 11 cubic foot freezers located on two different farms. One freezer consumed 727 kwhrs in 369 days. The other freezer consumed 751 kwhrs in 367 days. This project was completed in June 1947. For further information regarding these tests refer your questions to this company.

3. OREGON -- This is a cooperative project between Oregon State College and the Agricultural Engineering Research Foundation. The budget of the Agricultural Engineering Research Foundation is made up from contributions by the power companies of the state. The purpose of this investigation was to test the efficiency and correct the imperfection in the 12 cubic foot freezer designed the previous year. This particular freezer has a 12 cubic foot capacity box with 2 front opening doors. It has proven very satisfactory and the energy consumption per day has been quite low. One test showed that it requires 2.1 kwhr per day while maintaining a zero degree temperature on the bottom tray of the box with an ambient temperature of 69° F.

FARM SHOPS

1. IDAHO -- Planned electrified farm shop. This is a completed CREA project in Idaho. A study has been completed and information published on how a shop should be planned and arranged including design and construction, lighting, electrical wiring, heating and ventilating, the arrangement of benches and tables, parts bins, and tool racks, equipment arrangement and safety ideas.

FEED GRINDER TESTS

1. TEXAS -- This project was conducted by Texas A & M College. The electric operating companies that serve the state contributed to the funds necessary to carry it out. For a number of years agricultural engineers with the College and farm service representatives of the power companies have worked very closely with manufacturers and farm operators in developing practical electrically operated feed grinders for individual farm use.

One of the important phases of this work has been laboratory tests at the College to determine the power requirements, capacities, and operating characteristics of new or redesigned feed grinders as they are introduced by the manufacturer. One purpose of these tests is to check the operation of the mills when processing the feeds used on Texas farms against the capacity tables shown in the manufacturer's literature. The tests on which the manufacturer's recommendations are based are usually made in sections of the country where the types and moisture content of the feed may be quite different from those on Texas farms. Frequently the results of the tests have enabled the manufacturer to make improvements in design.

The tests also afford "local" information for dealers, farm service representatives, Extension agents, and teachers of vocational agriculture to use in making recommendations to farmers.

During the past two years, J P Hollingsworth, Research Assistant in farm electrification, has conducted a series of tests with five mills introduced or changed in design within the past few years.

As these tests are completed, the results are first checked with the manufacturer, then released for general information. The following are a few typical results from the test:

FEED GRINDER TESTS (Continued)

Viking (1 hp) -- Grain sorghum through 1/4" screen -
642 lbs per hour - 2.58 kwhr per ton

Bell No. 10 (2 hp) -- Shelled corn through 1/2" screen -
984 lbs per hour - 4.56 kwhr per ton

Bell No. 20 (5 hp) -- Grain sorghum through 3/16" screen -
2300 lbs per hour - 3.44 kwhr per ton

Sparton (5 hp) -- Grain sorghum through 1/4" screen -
3165 lbs per hour - 3.02 kwhr per ton

Smalley (5 hp) -- Grain sorghum bundles through 1-1/2" screen -
2049 lbs per hour - 6.44 kwhr per ton

FOOD PRESERVATION

1. INDIANA -- A study of Food preservation by canning and freezing. This project is being conducted at Purdue University in cooperation with the USDA. Funds were provided by the Indiana Electric Association and supplemented by state and federal funds. This is a cooperative project between Home Economics, Agricultural Chemistry, and Agricultural Engineering. The objectives are (1) to compare the cost of preserving foods by canning and freezing, (2) to study the amount of time required by each method, and (3) to judge the desirability of the finished product for the use to which it is to be put by means of palatability studies. The Agricultural Engineering Department supplied metered equipment. This project was discontinued and it is planned to activate it again in 1950.

FROST PREVENTION

1. MICHIGAN --The Detroit Edison Company is planning to make a study of the use of low temperature plastic covered resistance tape in the prevention of frost, in the next twelve months.

GARDEN PEA SHELLER

1. OREGON -- This is a cooperative project between Oregon State College and the Agricultural Engineering Research Foundation. The budget of the Agricultural Engineering Research Foundation is made up from contributions by the power companies of the state. The purpose of this experiment was to develop a small pea sheller that would be suitable for shelling peas for home canning or freezing or for custom service at frozen food locker plants. A small sheller driven by a 1/2 hp motor was developed and proved to be quite satisfactory. Further development work will be done on this machine in order to improve its efficiency.

GERMINATION OF SEEDS

1. INDIANA -- Design and construction of a low temperature seed germinator. This project is being conducted at Purdue University in cooperation with USDA. Funds are provided by the Indiana Electric Association and supplemented by state and federal funds. A five cubic foot experimental seed germinator of the cold wall principle was designed and constructed for prechilling cereals at 5 degrees centigrade prior to germination. The experimental germinator does not dry out the substratum and has a more uniform temperature than the commercial germinators. The paper "Design and Construction of a Low Temperature Seed Germinator" by L S Shenberger, Glen E Page, and H S Carter is published in the 1947 Proceedings of the Association of Official Seed Analysts, pages 99-101. Future work will consist of further tests on existing germinators and the design of an alternating temperature seed germinator for the State Seed Laboratory.

GLADIOLA BULB STORAGE

1. OREGON -- This is a cooperative project between Oregon State College and the Agricultural Engineering Research Foundation. The budget of the Agricultural Engineering Research Foundation is made up from contributions by the power companies of the state. The purpose of this project was to develop methods and equipment for drying gladiola corms after digging to prevent spoilage in storage due to botrytis rot. The losses due to rotting of the corms is the biggest single item of loss to the growers. Our research work has indicated that drying these corms immediately after digging for a period of 24 hours at a temperature of 90° to 100° F will practically eliminate the loss due to the botrytis rot. Our data indicates that these corms can be successfully dried in commercial trays 3-5/8" thick in 24 hours with an air temperature of 95° and an air velocity of about 200 feet a minute over the top of the trays.

GRAIN DRYING

1. INDIANA -- Development of Mechanical Equipment and Methods for Drying Corn and Other Grains. This project was conducted by Purdue University in cooperation with USDA. The Indiana Electric Association donates funds to the University. These funds are supplemented by state and federal funds.

The objectives of this project were, (1) to determine the optimum ranges of air temperature and rates of air flow for economical drying of corn and other grains in farm type cribs and bins, (2) to determine when forced ventilation of natural air and supplemental heat should be used, (3) to determine practical and efficient methods of

GRAIN DRYING (Continued)

distributing air through ear corn to be dried in various types of farm cribs with heated air, (4) to make performance tests in the laboratory including heat output, air delivery and efficiencies of heaters and fans and (5) to demonstrate the use and value of practical farm driers in conditioning high moisture corn and grain for safe storage. Under this project 22 tests, drying approximately 31,000 bushels of ear corn have been conducted cooperating with farmers, drier manufacturers and the U S Department of Agriculture. Detailed observations were made on fuel and electricity used, airflow, drying time, atmospheric and heated air temperatures, initial and final moisture content and relative humidity of the atmospheric air. The lots of corn dried ranged from 130 to 4000 bushels. The initial kernel moisture content ranged from 20% to 30%. the final moisture 10% to 18%. Cost for fuel and electric power varied from 1.7 to 11 cents per bushel, depending upon the amount of moisture removed, the type fuel, atmospheric air temperature, efficiency of the drying unit and methods of adapting the crib for drying. The mean temperature of the atmospheric air during the drying test varied from 14° to 65° F. That of the heated air ranged from 45° to 192° F. The overall thermal efficiency was 2.5% to 62.5%. Fuels used were fuel oil, kerosene, Diesel, gasoline and coal.

Also under this project, nine crop drying units were tested for manufacturers to help them develop suitable equipment for farm use.

Drying crops with forced air very definitely has a place as a yearly practice on most Indiana farms. Mimeograph 14, "Mechanical Drying of Ear Corn on Indiana Farms", has been prepared for general distribution to farmers. This publication gives advantages of mechanical drying of

GRAIN DRYING (Continued)

ear corn, methods of adapting cribs for drying, heat and air requirements for drying, a discussion on cost of drying, drying units and safety precautions. In addition it reports the results of 22 tests carried on under this project.

2. INDIANA -- Heat and Mechanical Energy Requirements in the Drying of Shelled Corn and Small Grains. The Indiana Electric Association provided funds to Purdue University to assist in the completion of this project. Other funds were made available by the state of Indiana and the federal government.

Drying experiments were run in the laboratory on the drying of shelled corn, wheat, oats, and soy beans using drying air at various levels of temperature, relative humidity and at different rates of air-flow through a grain mass eight feet deep. Also several tests were run in quantity lots in cooperation with farmers in the state. Drying costs have varied from 2.5 to 13.6 cents per bushel depending upon weather conditions, initial and final moisture of the corn, and type of installation.

To develop the theory of drying, thin layers of shelled corn, wheat and oats were dried in the laboratory using large volume of drying air at three levels of temperature and relative humidity and original grain moisture at two levels.

A mathematical expression was developed which expresses the relation between moisture content and drying time. These results are published in a master's thesis "Factors Influencing the Maximum Rates of Air Drying Shelled Corn in Thin Layers", and also reported in a paper

GRAIN DRYING (Continued)

"Drying Shelled Corn in Thin Layers", before the 1948 winter meeting of the American Society of Agricultural Engineers at Chicago. This paper is ready for publication. A paper "Predicting Moisture Distribution Through Shelled Corn During Bulk Drying" is now being prepared.

Future work will include the completion of the necessary tests on wheat and oats so that drying of these grains can be determined as accurately as for shelled corn.

A bulletin is being prepared on drying of shelled corn and small grains.

3. MICHIGAN -- The Detroit Edison Company will make a study of corn drying installations in the next twelve months.

4. NORTH CAROLINA -- Nantahala Power Company is cooperating with county agents and farmers in two counties in the study of drying hybrid seed corn with forced air and electric heat. The installations to be studied range in capacity from 65 to 85 bushels. No further details were reported.

5. OHIO -- These are the results of a test on drying corn conducted jointly by the Dayton Power and Light Company and Mr Ernest Beam, a stock farmer residing near Zenia, Ohio:

Time required to dry 1600 bushels (shelled)	- 144 hours
Kwhrs required to dry 1600 bushels (shelled)	- 766 kwhr
Cost for energy to dry 1600 bushels (shelled)	- \$21.90
Cost per bushel for electric energy	- \$00.137
Gallons of oil to dry 1600 bushels	- 420
Cost of oil to dry 1600 bushels	- \$63.00
Cost per bushel for oil	- \$00.394
Total cost per bushel to dry	- \$00.531

Mr Beam dried 14,300 bushels of shelled corn in 69 days.

GRAIN DRYING (Continued)

6. OHIO -- Toledo Edison Company reports they completed projects during 1947-1948 on ear corn drying without supplemental heat and with supplemental heat, and also the drying of small grain without supplemental heat. No further details were reported.

7. NEW YORK -- The New York State Farm Electrification Council proposed a project on this subject for 1949. The electric operating companies contributed to this project through the Council. Their results are not known at this time. The following were their objectives. Wheat, oats, beans, etc., are often harvested with a moisture content too high for safe storage. Drying in bags should be possible with the same fan and motor used for hay curing.

- a. Determine air volumes, static pressures, and techniques for piling the bags of grain to obtain the best drying arrangement.
- b. Obtain data and information on farms where grain drying has been practiced for several years.

8. PENNSYLVANIA -- The Philadelphia Electric Company is experimenting with the use of hay finishing fans for grain drying. No further details were reported.

9. PENNSYLVANIA -- West Penn Power Company, cooperating with Penn State College. Study of methods for drying the grain varieties in the amounts grown in West Pennsylvania and with the storage facilities available. Work completed at end of 1948 grain drying season. Results were published in bulletin "Home Made Systems for Drying Hay and Grain in The Barn and Crib."

GRAIN DRYING (Continued)

10. OREGON -- This is a cooperative project between Oregon State College and the Agricultural Engineering Research Foundation. The budget of the Agricultural Engineering Research Foundation is made up from contributions by the power companies of the state. This project was on ear corn drying.

The purpose of this test was to test the operation, performance and feasibility of drying ear corn in cribs under Willamette Valley conditions. Small portable dehydrators were used and various quantities of ear corn were dried. The cost of fuel and electricity was found to vary from 5.16¢ to 9.8¢ per bushel depending upon the condition of the corn and atmospheric conditions.

GRAIN PROCESSING

1. WISCONSIN -- At the University of Wisconsin Research Farm in cooperation with the Wisconsin Utilities Association, a machine is being developed that will elevate grain, mix it, and grind it. Metal grain storage bins are being developed for use in conjunction with the machine.

GREENHOUSE VENTILATION

1. INDIANA -- A ventilation system for a greenhouse. This project was conducted by Indianapolis Power & Light Company. The tests were successful. Detailed results were not reported.

GRINDING EAR CORN

1. KANSAS -- This is a CREA project in Kansas with USDA cooperating. They are attempting to solve the problem of grinding ear corn with small electric motors. Viking Manufacturing Company is also cooperating in this project.

2. MICHIGAN -- The Detroit Edison Company is making a study at the present time in attempting to perfect a feed grinder that uses a series of dado saw blades revolving at high speed for grinding ear corn. No further details reported.

HAY DEHYDRATION

1. KANSAS -- This is a CREA project in Kansas with USDA cooperating. It is expected that the work will yield a clear evaluation of the problems and possibilities of farm-scale dehydrating.

HAY DRYING

1. INDIANA -- The Development of Bulk Hay Drying Systems Utilizing Heat and Mechanical Ventilation. This project is being conducted at Purdue University in cooperation with the USDA with funds provided by the Indiana Electric Association, and with state and federal funds.

The work under this project has been carried out both in the laboratory and in the field. The objectives of the laboratory work have been to obtain: (1) the moisture content at which hay for mow curing should be stored to obtain good quality at an economical cost, (2) The temperature rise (above atmospheric conditions) and relative humidity of the drying air needed to produce good quality hay when stored at

HAY DRYING (Continued)

various moisture contents, (3) The maximum depth to which hay can be effectively handled and dried, (4) The rate of air-flow required to dry hay before mold occurs in the upper layer, (5) The limitations imposed on the drying structure by the size of the mass of hay, the rate of airflow and the air conditions.

Eleven tests have been proposed in this study and to date all but two of the tests have been completed.

The second phase of this project is field tests of drying hay in the mow. In 1946, three tests were made drying baled hay in a 20 x 20 ft bin with a false floor one foot off the air tight hay mow floor. The three batches of hay were dried with forced natural air. Records were made of the amount of airflow, the initial final moisture content of hay, quantity of hay, the static pressure in various layers, and the electrical energy consumption. These tests were repeated in 1947 using an 8° to 12° temperature rise above the outside atmospheric air. They were again repeated in 1948 using approximately a 20° temperature rise above the atmospheric air. As a result of the three year's work on baled hay drying, a new system was designed and installed in the new Dairy Barn and with this system to date, two tests have been made using forced natural air in the daytime and supplemental heat at night. Of all the methods used to date the latter seems to have the most promise.

Feeding trials comparing the field and mow cured hay were made in 1946, 1947, and 1948 by the Dairy Department, and analyses of the carotene content in the hay, the cow's blood, milk and butterfat were determined by the Agricultural Chemistry Department. It was found that the carotene content of the cow's blood, milk and butterfat, followed the carotene content of the hay rather closely. In all cases there was

HAY DRYING (Continued)

not a significant difference between the carotene content of the mow cured and field cured hay, but when a significant difference would occur, it was reflected in greater gains and larger milk production.

In 1947, 10 tons of 44% moisture hay were dried in a Martin Haymaker which was 18' in diameter, 26' tall, with a 4' square center duct. Heated air was blown into the slatted center duct, through chopped hay and exhausted through the perforated sheet metal outside of the cylindrical building. An all-crop drier was used with a 24" propeller fan, powered by a 3 hp electric motor capable of burning 2-1/2 to 4-1/2 gallons of fuel oil per hour. The hay was dried to a final moisture content of 15% in 34 hours at a cost of approximately \$1.70 per ton of 15% moisture hay. This test was also repeated in 1948 using a larger quantity of hay. The main benefits to the Indiana farmer in running these tests was an improvement of the air distribution system. Approximately 100 of these buildings were sold in Indiana in 1947 and 1948. Most of these had a slatted duct system which did not give uniform air distribution. By working with the manufacturer a method was developed to give good air distribution in the existing buildings. A new duct system was designed which gives good air distribution and is easier for the farmer to operate. This duct is now furnished with all new buildings. With each of these structures is sold a 3 to 7 hp electric motor. In 1948 a method of drying hay on wagons was tested and found to produce high quality hay. With this system approximately one ton of 35% moisture hay can be dried to 15% moisture in approximately one hour at a cost of about \$1.75 per ton, using a drier with a 32" propeller driven by a 5 hp motor. The crop drier burns approximately 10 gallons of fuel oil per hour.

HAY DRYING (Continued)

2. NEW YORK -- The New York Farm Electrification Council of which the electric operating companies that serve the state are members have contributed to the research on barn hay curing. The following is the summary of this work taken from the progress report of the Council for the year 1947. The project was under the supervision of Cornell University.

No better method has yet been found to beat "Old Man Weather" in making hay than to force air through it to finish the curing in the mow. There are now more than 150 farms in the state with from one to six mow curing installations in use. To our knowledge, no farmer has ever discontinued the use of a mow curing system in the state. All farmers with these installations report savings in field curing time and finish their haying season with more tons of top quality hay in the barn. Many of these farmers have records to prove that their cows produce more milk on their mow cured hay than when they were fed field cured hay.

In contrast to these reports from farmers, the feeding trials conducted by the Animal Husbandry Department at the College show no more milk in the pail from the feeding of mow cured hay. The Agronomy Department reports that it is not uncommon for a farmer to expect a 29 per cent loss of dry matter when mow curing hay during periods of high outdoor humidity. They, therefore, recommend harvesting the early hay crop as grass silage rather than to use a mow curing system.

These reports then are again confused by the reports of three years of feeding research which has been conducted at the Agricultural Research Center, USDA, Beltsville, Maryland. Their reports showed that

HAY DRYING (Continued)

mow cured hay gave 7.6 per cent more milk in the pail than did field cured hay for the years 1945-1946 and 1946-1947. It has been recently reported that where some artificial heat was used with the conventional mow curing system the 1947-1948 results show that the cows produced 50 per cent more milk on mow cured hay as compared to the feeding of field cured hay.

Therefore, farmers and other Colleges as well as commercial interests are at a loss to know who to believe and what to recommend. Obviously someone has failed to control certain variables other than the kind of hay fed to cows in the feeding research.

Until such time as there is more reliable information on the feeding value of hay harvested by different methods, engineering work on this project cannot be justified.

The study on cost and other considerations in mow curing of hay has been completed and it showed the average cost on 27 farms was \$2.69 per ton of cured hay when a mow curing system was used. Thirty-one per cent of this cost was for electric power. Only .1 of a manhour per ton more was required to harvest and store mow cured hay than field cured hay. An average of 1.3 days of field curing was eliminated when the curing was finished in the mow. As much as 1.8 days was saved early in the season when mow curing can be of the most benefit to the farmer.

This work has been continued. For detailed information consult the New York State Farm Electrification Council at Cornell University.

3. CONNECTICUT -- The Connecticut Light and Power Company is now conducting a study of installed equipment of various types and sizes on farms to determine methods of operating, management procedure, pressure characteristics, and current costs. Data should be available in 1950.

HAY DRYING (Continued)

4. CONNECTICUT -- The Connecticut Light and Power Company is cooperating with USDA Farm Electrification Research Engineer, College of Agriculture, University of Connecticut, on technical studies regarding the use of hay drying systems on farms.

5. MICHIGAN -- The Detroit Edison Company is planning a study of prefabricated metal duct systems in the next twelve months.

6. PENNSYLVANIA -- West Penn Power Company, in cooperation with Penn State College. Study of management practices, type of air distribution system, and other factors needed for successful barn hay drier operation under Western Pennsylvania conditions. Project completed at end of 1948 hay harvest season. Results are published in bulletin, "Home Made Systems for Drying Hay and Grain in the Barn and Crib."

7. PENNSYLVANIA -- West Penn Power Company in cooperation with Penn State College. Study of the size of Hay Drier center open duct to use in various sizes of bank barn mows. Study completed at end of 1949 hay harvest season. Results will appear in a crop drying bulletin for the 1950 Pennsylvania Farm Show at Harrisburg.

8. PENNSYLVANIA -- West Penn Power Company in cooperation with Penn State College. Investigation of methods, other than by vertical flue formers, to get more air to the tops of high narrow mows. A sectionalized secondary duct which was fed air from the open center duct on the mow floor through a vertical flue was tried in two barn hay drier installations in 1949. Results were encouraging, but not conclusive. Further study of this problem is planned.

HAY DRYING (Continued)

9. TEXAS -- Drying baled alfalfa. This project was conducted by Texas A & M College. The electric operating companies serving the state contributed funds to assist in carrying out this project. Five different types of air distribution systems were used:

1. A "sub-floor" of 1" x 2" boards spaced 6" on center, 3' above the barn floor.
2. A "sub-floor" of 12-1/2 gauge, welded, steel 1" wire mesh 6" above the barn floor.
3. A movable "tunnel" of heavy, welded, steel wire mesh approximately 7 1/2' wide, 2' high and 10' long placed on the barn floor.
4. A movable wire mesh "tunnel" 4' wide, 4' high and 10' long placed on the floor of the barn.
5. A "tunnel" made by leaving a space in the center of a stack of bales.

The bales of hay were stacked on the sub-floors or around the tunnels at various thicknesses up to 5 layers. In some tests the bales were packed tightly together and in others, spaces for air circulation were provided by leaving openings of 2" to 4" between bales.

The temperature of the heated air as it entered the hay varied from 138° F to 200° F. A commercial "package-type" portable heating unit and the heating system permanently installed for hay drying in the barn were used as sources of heated air.

The alfalfa was allowed to dry in the swath in the field to a moisture content of approximately 50% before baling. The moisture content at the end of the drying period was approximately 12-1/2%.

10. VERMONT -- A study of 36 typical farms having hay driers and an equal number of farms without them. This study is being conducted by Central Vermont Public Service Corp to determine value of hay drying equipment.

HAY DRYING (Continued)

11. CALIFORNIA -- As a result of studies made on California farms, an extension circular, Barn Mow Hay Drying has been issued by the California Extension Service. This circular sets forth hay drying procedure, types of installations, fans, etc., and a method of testing moisture content of hay. This bulletin can be secured from the Extension Service of California. Reported by Pacific Gas & Electric Company.

12. MAINE -- A continuing project on mow hay finishing is being conducted by Central Maine Power Company.

13. PENNSYLVANIA -- The Philadelphia Electric Company, Coatesville, Pennsylvania, reports that they are making continuing studies on the effect of 5 and 7-1/2 hp motors on load factor on hay finishing installations.

14. WEST VIRGINIA -- Monongahela Power Company reports a continuing project in cooperation with the West Virginia University Agricultural Engineering Department on the use of an oil burner on a bale hay drier installation.

15. WISCONSIN -- The companies of Wisconsin are cooperating with the University of Wisconsin at their Research Farm and have a continuing project on mow hay drying.

HEAT PUMP

1. KANSAS -- The heat pump study is a CREA project in Kansas. The electric operating companies of Kansas contribute to this organization and are members of the committee. USDA is also cooperating.

The following is a brief report on this project as reported on

HEAT PUMP (Continued)

August 30, 1949:

The heat pump field tests are progressing satisfactorily.

Arrangements made with the building contractor have worked out very well.

One series of tests circulating hot water in the buried pipe has been completed and another test is under way.

All instruments and equipment for the laboratory phase of the heat pump work are on hand. Some of the control instruments as received from the factory did not meet the specifications. This has caused considerable delay in the work. Mr Trent has analyzed the trouble and by working with an engineer sent out from the factory, has made modifications on the instruments. He thinks that they will now perform satisfactorily.

Mr Trent has been continuing his investigation of the performance of a Marvair heat pump in a farm home at LeMars, Iowa. In cooperation with Iowa State College, data is being taken on the summer cooling operation. Mr Trent's report on the winter operation of the unit is now available to any of you who request a copy. Farm Implement News published a very good article by Mr Trent in their August issue. The article, "The Heat Pump in Agriculture" deals with the operating principle of the heat pump and explains the possibility of various applications on the farm.

The heat pump at the Kansas Power and Light Company's sub-station north of Manhattan has demonstrated some of the problems that may be encountered in the practical application of ground coils for summer cooling. The cooling cycle has not been considered a serious problem by the majority of people throughout the country who are interested in heat pump investigations. Experience with the installations at the sub-station indicates that the problems involved in cooling with a ground

HEAT PUMP (Continued)

coil are more difficult than those encountered on the heating cycle. The unit has been operating satisfactorily since a few modifications were made during the latter part of July. Mr Hinrichs has further plans for improvement of the performance of the unit.

At least four, possibly more, Marvair heat pumps are being installed in Kansas farm homes. These units should demonstrate pretty clearly just what can be expected from this particular brand of heat pump, under Kansas conditions.

HOISTS - ELECTRIC HAY

1. CALIFORNIA -- A CREA project. Studies were made on type of operation of electric hay hoist. An Extension circular was issued giving the results of these studies by the California Extension Service.

INFRA-RED LAMPS IN CALF PENS

1. IDAHO -- Use of Infra-red lamps as an aid in keeping the litter dry in calf pens. This is a CREA project. It was begun in 1948 and has continued through 1949 to determine if heat lamps are practical to dry calf pen litter during winter weather.

INSECT CONTROL (Corn Borer)

1. INDIANA -- Use of Radiant Energy and Electric Traps as a Possible Control for the European Corn Borer. This is a cooperative project conducted at Purdue University in cooperation with USDA. Funds are provided by the Indiana Electric Association and supplemented by state and federal funds.

INSECT CONTROL (Continued)

This project was initiated in January 1947 with these objectives:

(1) to determine the particular source of radiant energy most attractive to the European Corn Borer Moth, (2) to study the types of traps and their field spacing in regard to their effectiveness in capturing corn borer moths, and (3) to determine the effectiveness and the practicability of using electric energy for the control of the European Corn Borer.

Field tests on the wavelengths of energy most attractive to the corn borer moth were made with five sources of energy of narrow bandwidths during the summer of 1947. It was determined that radiations peaking at 3650 Angstroms in the ultra violet region were most attractive.

In 1948 laboratory tests made with 7 different sources indicated that the fluorescent lamp "360 BL" was the most attractive lamp commercially available.

It was found that higher intensity sources in the field attracted more moths, but not in proportion to the increase in intensity.

In 1949 field tests with electrocutor grids were made over a twenty-two acre early planted sweet corn field and although a reduction in infestation was obtained, results have not as yet been completely analyzed. Further tests are also being conducted on high intensity lamps and trap design.

In the next two years further testing of traps in their field placement will be made. The final test will be to determine if the radiant energy source and trap developed is economically feasible for European Corn Borer control.

INSECT CONTROL (Continued)

2. MAINE -- The University of Maine and the electric operating companies that serve the state are cooperating on this project. No details were reported.

JUICE EXTRACTION

1. CONNECTICUT -- Fruit and vegetable grinder and juice extractor. The Connecticut Light and Power Company is now conducting a project to devise a small electrically driven heavy duty device for farm family use in making a home supply of cider and vinegar. It will also be used for grinding or extracting juice from other farm products. Information will be available in 1950.

LAND DRAINAGE AND IRRIGATION

1. MICHIGAN -- The Detroit Edison Company reports a completed project involving the study of the use of a 5 hp propeller type pump used in the drainage of 160 acres of muck land. No details reported.

2. MICHIGAN -- Consumers Power Company is continuing their long-time studies of the drainage and irrigation of their vegetable growing sections.

3. MINNESOTA -- Northern States Power Company is studying the installations of 3, 5, $7\frac{1}{2}$ and 10 hp motors on market gardening plots. They are also studying the operation of 20 hp and 2-20 hp motors used in field irrigation of potatoes and sweet corn.

4. OHIO -- Toledo Edison Company reports studies of pump drainage of farm land on 20 to 200 acre plots. No further details were reported.

LAND DRAINAGE AND IRRIGATION (Continued)

5. UTAH -- Utah Power & Light Company reports the following on drainage of irrigated lands:

In Utah, irrigation and drainage are basic necessities for the production of agricultural crops. Nearly four-fifths of Utah's farm income is from irrigated farms. However, irrigation of land sooner or later brings with it the problem of adequate drainage. After careful study of the basic needs of agriculture in Utah, in June of 1947, the Utah Power & Light Company entered into an agreement with the Utah Agricultural Experiment Station for a cooperative research project, with the purpose of projecting new research on the drainage of irrigated lands, through a liberal grant by our company for that purpose.

The research project is entitled "The Drainage of Irrigated Lands" and its objects are briefly as follows:

1. To develop new and improved methods, operating and maintenance of drainage systems, both gravity and pumping.
2. To develop improvements in the design, the placing and the maintenance of drainage tile, with special reference to prevention of inflow of excessive silt and clay which clog tile drains and necessitate very costly cleaning and abandonment.
3. To develop a clear understanding, by field inspection and experiment, of the reasons for successful drainage of 100,000 acres of Utah irrigated land, now well drained, and of the reasons for failure of the drainage systems covering an additional 100,000 acres.
4. To find the conditions under which and the extent to which, drainage by pumping is preferable to drainage by gravity systems and to design, locate, drill and develop drainage wells so as to obtain maximum water yield per foot of draw down and thus decrease drainage costs.

This project so far covers the school years of 1947-1948 and 1948-1949 with the expectation of both parties to continue cooperative

LAND DRAINAGE AND IRRIGATION (Continued)

research for a period of five years or more, toward contributing to the answer of the problem.

The cooperative drainage research results to date are presented by four reports or theses of research fellow scholarship students financed by the Utah Power & Light Company, as follows:

"The Drainage Problem in the Lewiston Area"
By Sterling Davis, June 1948.

"The Drainage Problem in the Draper Area"
By Stanley H Van Orman, September 1948.

"Design of Shallow Wells for Drainage by Pumping,
Lewiston Area, Utah"
By Gregory L Pearson, June 1949.

"Drainage by Pumping in the Lewiston Area, Utah,"
By Paul J Pehrson, September 1949.

Very briefly summarized, these reports include design of and performance of 3,600 foot lengths of gravel-covered tile drain; the design, locating, drilling and developing of a large diameter shallow well for drainage; horizontal gravel envelope well point drains; and vertical gravel envelope well point drains connected in series.

These drainage research studies were conducted in the field and while the major portion of the expense has been shared by the Utah Power and Light Company and the Agricultural Experiment Station of Utah, there were contributions by the various drainage districts in the area of the projects and by a local sugar company upon whose land the 3,600 foot tile was installed.

LIGHTING

1. CALIFORNIA -- Turkey lighting. The current study was designed to give additional information about all-night lights in comparison with birds on 14 hours, and also to determine whether a ration with a higher vitamin A, D and riboflavin content would improve hatchability of eggs laid by birds on all-night lights. This is a CREA project now being conducted but not completed.

LOAD STUDIES, AND FIELD STUDIES TO DETERMINE OPERATING COSTS

1. CONNECTICUT -- Rural Line Loading Study. The Connecticut Light & Power Company is now making a study from an operating point of view to determine characteristics of rural line loadings with particular emphasis on the effects of (large) farm equipment. A special study of hay driers of various sizes and types is included. A report on this study is expected to be available late in 1950.

2. ILLINOIS -- Future Electrical Requirements. Central Illinois Light Company is making a study in cooperation with the University of Illinois in their DeKalb Division, so that a complete rural electrification program for construction of the necessary rural distribution system can be made.

3. INDIANA -- Field studies to get first-hand information on operating cost, labor requirements, savings and profits provided by their use. This project will be conducted under the supervision of Purdue University. Funds will be provided by the Indiana Electric Association supplemented by state and federal funds.

Items or subjects upon which field studies will be started as soon as possible are as follows:

LOAD STUDIES, AND FIELD STUDIES, etc (Continued)

1. Water systems
2. Electric welders
3. Dairy barn cleaners
4. Electric fans for ventilation
5. Milk coolers
6. Dairy pasteurizers
7. Water heaters
8. Milking machines
9. Stock tank heaters
10. Poultry and pig brooders
11. Portable farm motors
12. Feed grinding and mixing
13. Feed elevating
14. Automatic electric poultry feeders

4. PENNSYLVANIA -- The Philadelphia Electric Company reports the continuing study to determine the effect of 5 and $7\frac{1}{2}$ hp motors on load factor when used on hay finishing installations. No details were reported.

MANURE PUMPS

1. CALIFORNIA -- A CREA project. This project was completed and an Extension circular has been issued on the selection and use of manure pumps on dairy farms.

MANURE STORAGE PIT

1. WISCONSIN -- At the University of Wisconsin Research Farm in cooperation with the Wisconsin Utilities Association, a manure storage pit is being developed to take care of the manure in the winter months where the mechanical barn cleaner is used. The difficulties with snow and mud conditions in getting the manure on the land every day of the year indicate need for a manure storage for parts of each year.

MILK CAN LIFTING

1. CONNECTICUT -- The Connecticut Light & Power Company is now conducting a project in cooperation with an individual engineer to develop a device for lifting cans of milk in and out of coolers. Data should be available early in 1950.

MILK COOLING

1. IDAHO -- The CREA in Idaho has completed a project on the study of milk cooling in that State. The information has been published in leaflet form.

2. LOUISIANA -- Louisiana Power & Light Company ran tests over a twelve-month period under actual farm conditions on the kilowatthour consumption of one 4-can and one 8-can milk coolers. The 4-can cooler consumed an average of 1.45 kwhr per 100 pounds of milk cooled. The 8-can cooler consumed an average of 1.49 kwhrs per 100 pounds of milk cooled.

MILK HOUSE HEATING AND MILKING PARLOR HEATING

1. MAINE -- The University of Maine and the electric operating companies that serve the State are cooperating on this project. No details were reported.

2. MICHIGAN -- The Detroit Edison Company reports a completed project on the study of the use of a 1500 watt unit space heater. No details reported.

3. MICHIGAN -- The Detroit Edison Company is planning to make a study of heating the milk house with heat given off by milk cooler in the next 12 months.

MILK HOUSE HEATING AND MILKING PARLOR HEATING (Continued)

4. MICHIGAN -- The Detroit Edison Company is planning a study in the next 12 months on the use of rubberized radiant heating panels to heat milk houses.

5. MICHIGAN -- Consumers Power Company is now doing investigational work regarding the heat pump method of heating the milk house and also the use of heat lamps.

6. MINNESOTA -- Northern States Power Company reports as follows:

We are studying milk house heating and the milking parlor heating on the farm. Milk house heating consists of direct heat application from the milk cooler and heat from the circulation of water from the electric water heater. We are recommending the installation of heat lamps for the comfort area in the milking parlor. Our reports are not complete on these projects, although we are able to give some results. In milk house heating we are sponsoring, in so far as possible, the use of the heat from the milk cooler and supplementary heat by running fresh water through the milk cooler. Thus, using the milk cooler as a heat pump. We have reported and you have desirable reports on this operation. With one reasonably large milk house handling 12 to 14 cans of milk per day through a 1 hp milk cooler, the additional heat needed by running water through the cooler cost the farmer approximately 60¢ for the coldest week of last winter, including an estimated cost for water pumping. Water is put into this milk cooler at approximately 100 gallons per hour. We estimated the requirements at approximately 2500 gallons for the week mentioned. The meter registered 3,000 gallons which we believe was caused by visitors demonstrating the starting of the cooler.

MILK HOUSE HEATING AND MILKING PARLOR HEATING (Continued)

7. OHIO -- Ohio Power Company reports they have completed a study to determine the size of resistance heaters to maintain 40° temperature in milk houses of different sizes and types. Best results occurred when a 3 kw 220 v heater regulated by a thermostat was recommended owing to failure of most farmers to provide adequate insulation.

8. NEW YORK -- The New York State Farm Electrification Council has proposed a study for 1950 to secure milk cooler operating data and pounds of milk records to determine heat input to milk house from this source. They plan to continue to observe the operation of two milk house heaters supplied by manufacturers for general adaptability to this application. They are radiant glass.

9. PENNSYLVANIA -- West Penn Power Company reports:

- a. Study of the adaptability of the blower type electric heater to the heating of milk houses. It included observations for the purpose of evaluating such factors as operating cost, thermostat location, amount of insulation, type of milk house construction, and other heat sources.
- b. Study of the adaptability of radiant type heater to the milkhous.

Relative to Project A, the following is reported: Because of the relative mildness of this particular winter, further observations are to be made during a comparable period this coming heating season.

Project B is to be conducted during the winter of 1949 and 1950.

10. WISCONSIN -- The Wisconsin Public Service Corporation made the following study:

MILK HOUSE HEATING AND MILKING PARLOR HEATING (Continued)

Early in 1947, requests from farmers for electric heaters for prevention of freezing in milk houses were so numerous that plans were made to study the milk house heating problem.

A survey was made covering approximately 120 farms in seventeen counties in Northeastern Wisconsin. The survey showing the following:

1. 58% of the dairy farmers had milk houses and that in the winter months those without milk houses kept the milk in the dairy barn.
2. Less than 10% of the farms surveyed were using mechanical milk coolers.
3. Over 50 per cent of the milk houses in use were constructed of cement blocks, lightweight aggregate or cinder blocks.
4. 85% of the milk houses were equipped with cold water under pressure and 60% of them had a limited supply of hot water.
5. With the exception of a few partially insulated ceilings all of the milk houses were uninsulated and without storm doors or storm windows.
6. All owners reported trouble with frozen water pipes and formation of ice on floors, walls and ceilings in the winter.
7. The average milk house size, inside dimensions, was 10' x 14' x 7'6".

As we are a combination gas and electric utility, the information gathered was turned over to our experienced gas Home Heating Engineers. Their conclusions after studying the information were these: the average milk house would require an input of approximately 2050 kwhr to prevent freezing from November to March, inclusive. In some instances, the calculations showed needed input exceeding 2600 kwhr for the above season and in those instances where mechanical milk coolers were used, the average need appeared to be 1420 kwhr per season. The amount of hot water a farmer might use in his milk house if an adequate supply of hot

MILK HOUSE HEATING AND MILKING PARLOR HEATING (Continued)

water was available was not known. Later by observation of some fifty installations, it was found that the daily use of hot water ranged from six gallons to forty-six gallons and that the average use was 13.35 gallons per day.

To meet the problem in the best possible manner and at lowest possible cost to the user, it was evident that the following factors and principles would have to be heeded:

1. The value of good insulation and vapor proofing materials would need to be stressed.
2. As the average rate for electricity, for room heating purposes, in the area was 2.7¢ per kwhr it was obvious that electricity for heating would be expensive and unpopular.
3. The use of hot water in the milk house increased when an adequate supply was available.
4. As milk house sanitation regulations required a reasonable supply of hot water and indications were strong that in the future farmers were going to be urged to use more hot water, it seemed logical that the electric water heater could be used to provide both room heat and hot water.

As more than 90 per cent of the farm users of electricity had "off peak rates" of .01¢ per kwhr or less available to them our rate department was approached for approval of use of the "off peak" electric water heater for milk house heating.

The use of 50 gallon or larger storage type electric water heaters was adopted. The installations were designed to maintain minimum indoor temperatures of 40°. The market was searched for reasonably priced hot water unit heaters with capacities of 10,000 to 20,000 Btu per hour when used with 160° water in the 40° room. The unit heaters were connected in such manner that the heat trap with which practically all storage heaters are equipped was by-passed and the cold water or return

MILK HOUSE HEATING AND MILKING PARLOR HEATING (Continued)

line from the unit heater was interconnected with the cold water line supplying the storage heater. 1-1/4 inch diameter pipe lines were used in the first few installations to interconnect the unit heaters and storage water heaters as a matter of assuring free circulation of water without the use of circulating pumps. The operation of the unit heater fan was controlled by a wall mounted thermostat adjusted to start the fan at 40°. It was soon found that some means of controlling circulation of the hot water was necessary as circulation was continuous and temperatures at times went to 50° or over in the milk house. Following this experience, 1-1/4 inch solenoid valves were used on subsequent installations. These valves were placed in the hot water line between the electric water heater and the unit heater. The coil of the solenoid valve is connected to the thermostat circuit with the unit heater fan. When the thermostat contacts close for a heat increase, the solenoid valve opens permitting circulation of hot water and the unit heater fan operates to drive heat into the room. Later it was found that free circulation of the water could be obtained with the use of 3/4 inch diameter interconnecting pipe lines and this pipe size is now used on all installations. As the unit heater is always mounted above the electric water heater, some small trouble with air binding or locking was experienced. It was found that air would collect in the unit heater and prevent circulation of the hot water. As some of the unit heaters used were not equipped with air vents, a two inch diameter ten inch long air dome or air receiver with a 1/8 inch brass petcock was installed in the line between the water heater and the unit heater. As the air receiver has considerable air capacity, it is necessary to open the petcock for air purging every third or fourth week only.

MILK HOUSE HEATING AND MILKING PARLOR HEATING (Continued)

At the present time (September, 1949) there are more than sixty of the "off peak" milk house heating installations in use. Indications at the moment are that an additional fifty or sixty installations will be in use after January 1, 1950.

During the months of November, December, January, February, and March of 1948 and 1949, eighteen of the installations were checked over the five month period and the findings were these:

Average daily use of hot water - 13.3 gallons

Average monthly use of electricity to maintain room temperature of 40° in milk houses ~~where~~ mechanical milk coolers were not used - November-230 kwhr; December-212 kwhr; January-220 kwhr; February-363 kwhr; March-234 kwhr.

Where mechanical milk coolers were in use -- November-170 kwhr; December-142 kwhr; January-140 kwhr; February-250 kwhr; March-175 kwhr.

Average installation cost (includes storage type electric water heater, unit heater, thermostat, solenoid valve, air receiver, wiring and plumbing) - \$279.00.

As a supply of hot water was compulsory on practically all of the owners and heat for prevention of freezing was necessary the owners were faced with two choices, the "off peak" system and pour in type electric water heater, a thermostat, a resistance type electric room heater and the wiring necessary to connect the alternative equipment. As the latter equipment and its installation cost totals \$114.00, the installation of the "off peak" system can logically be assumed to be an added cost proposition. On this basis the added cost of the "off peak" system as compared to the equipment meeting barest minimum needs is \$165.00. Since the off peak rate is not available for resistance type electric heaters or pour in type electric water heaters, a comparison of operating costs of the two systems shows the "off peak" system costing

MILK HOUSE HEATING AND MILKING PARLOR HEATING (Continued)

\$30.99 less per season.

1823 - kwhr average for room heat and water heating November to March inclusive.

$$\begin{array}{rcl} 1823 \times 2.07\phi & = & \$49.22 \text{ On regular service circuit} \\ 1823 \times .01\phi & = & 18.23 \text{ On "off peak" circuit} \\ & & \underline{\$30.99} \end{array}$$

The installation cost difference is liquidated by the saving in operating cost within slightly more than five years. To the average farmer, this is a thrifty investment.

MILK PASTEURIZATION

1. TEXAS -- Texas A & M College is in the process of making a study involving certain methods of pasteurizing milk. The electric operating companies of Texas have contributed to the execution of this work.

Of interest to operators of milk processing plants and electric service companies is an all-electric milk pasteurizer recently introduced by the Pure-Pak Division, Ex-Cello Corporation, Detroit, Michigan. In this unit, the milk is heated quickly to pasteurizing temperatures by passing electric current through a thin column of milk. The resistance of the milk to the flow of electricity creates the heat.

At least two of these units were installed in creameries in Texas in 1948. One near McKinney, and the other at the Lamar Creamery at Paris. The advantages claimed for this pasteurizer are:

1. Speed of operation - only 90 seconds is required for pasteurization.
2. Compactness -- A unit with a capacity of 10,000 pounds of milk per hour occupies a floor space of only 52-1/2" x 100". The over-all height is 72".

MILK PASTEURIZATION (Continued)

3. Automatic temperature control within very narrow limits.
4. Positive Operation -- If milk fails to reach pasteurization temperatures as it passes through the unit, automatic controls return the milk to the heating compartment.

One characteristic of the equipment presents a problem to both the plant operator and the electric company supplying the service. The electrical demand is relatively high, varying from 18 kva for a unit with a capacity of 1300 pounds of milk per hour to 90 kva for a unit with a capacity of 10,000 pounds of milk per hour.

Through the cooperation of D S Coffman, manager of industrial sales, Texas Power and Light Company, Dallas; Mr W E Whittington, Paris, district manager of the same company; and the manager of the Lamar Creamery, complete records are being kept on the operation of the pasteurizer at Paris. These include:

1. A continuous record of total electrical demand of all equipment installed in the creamery.
2. A continuous record of the electrical demand of the pasteurizer.
3. Thoroughness of pasteurization.
4. Amount of milk pasteurized.
5. Cost of operation, including repairs, service, labor, and electricity.

2. NEW HAMPSHIRE -- New Hampshire Gas and Electric Company reports a cooperative project with the University of Connecticut. The following is a progress report on their experimental small farm pasteurizing.

Small Farm Pasteurizer--The Key to the Situation on Many Small Dairy Farms. Dairy equipment manufacturers have long catered to big milk

MILK PASTEURIZATION (Continued)

distributing plants and such research work has been done and new equipment installed which has all been to the good and to the benefit to the milk industry. Nevertheless, the small producer-distributor has been the forgotten man, measured in terms of improving the quality of milk retailed in small communities. There has been some effort made to pasteurize milk on the farm and some small-sized equipment is available from several concerns.

In 1941, the University of Maryland, Agricultural Experiment Station, did considerable work on a small electric, holder-type pasteurizer. Later, the University of Connecticut experimented with a modified, short-time pasteurizer for farm and home use. More recently, there has been available through the H E Wright Company, Cambridge, Massachusetts, a 53 quart "In-The-Bottle" pasteurizer. There is a concern in Michigan which is now offering pasteurizers from 20 gallons to 500 gallons capacity. The Cherry-Burrell Corporation, manufacturers of dairy equipment, make a small farm pasteurizer called the 30-gallon Univat. In short, much of the work that has been done along pasteurization lines has been all to the good, but assembled on the small dairy farm, costs have been beyond the reach of the average small producer-distributor and at the same time, installation has been both intricate and too expensive.

Here in New Hampshire, there are over 800 small producer-distributors of raw milk. These small dairymen are located near our urban and small factory towns, and on the borders of some of our larger cities. From our recent surveys in three counties, we find the volume of milk sold by any one of these producer-distributors will average between 50-200 quarts of milk per day. In our contacts with dairymen in three counties,

MILK PASTEURIZATION (Continued)

Strafford, Belknap and Merrimack, many of the dairymen have expressed it this way, "If we just had an economical method of pasteurizing our milk here on the farm, we could possibly expand our business, or at least hold the demand which we are increasingly getting for our milk, pasteurized." They are uneasy about the future. If they are eventually required by law to pasteurize all their milk, and scattered as they are, it is not economical to have their small supplies custom pasteurized, nor would it be feasible for them to cooperatively pasteurize the milk of a member group because of lack of sufficient volume. Consequently, our committee, in studying the situation, decided to attempt to have a small pasteurizer -- 30-gallon capacity - built that would meet the needs of the average small dairymen retailing their own milk. With the aid of funds from the Research and Marketing Project, and cooperation from a manufacturer, an experimental pasteurizer was built and tests made by the Agricultural Engineering Department and the Dairy Department of the University of New Hampshire. In our initial work, we found that the ordinary electric hot water heater did not give us sufficient volume of hot water to do the job. In this pasteurizer we are pumping water heated at 185° , spraying it over the surface wall of the pasteurizer, with a return into the holding tank. The milk, while being heated to pasteurization temperature and for 30 minutes while being pasteurized and also cooling, is agitated by means of a small electric motor which is mounted on the pasteurization tank. By this spray process it has been possible to heat the milk from 90° to 143° in 20 minutes time, hold the milk at 143° for 30 minutes and cooling the milk down to 90° in an additional 20 minutes. This total time, using manual controls is 110 minutes. If the milk is to be cooled down for bottling to 50° ,

MILK PASTEURIZATION (Continued)

it is estimated that it will take another 20 minutes. It would take approximately one hour and a half for the pasteurization and cooling to 50° of 120 quarts of milk. For bottle sales, milk should be cooled over an aerator to 50°.

We are now using a semi-scalding tank of 100 gallons, heated with electricity and thermostatically controlled. The heat loss of this water in raising the temperature of the milk from 90° to 143° has averaged around 35°. We have pasteurized on an average of 100 quarts of milk daily, which in terms of electricity used is 7,000 Btu's, or approximately 2 kwhr of electricity, in reheating the water to have it ready for the next job of pasteurization. Two kwhr of electricity would cost about 8¢ per day, depending upon the rate in the area. Allowing for radiation, do to ambient temperatures, we can add another 2¢, making the total cost of electricity used per day through the summer season of around 10¢. In winter time, heat losses will be greater and it can be expected that it might cost around 12¢ to 13¢ per day to heat the water for pasteurizing 100 quarts of milk daily.

One of the advantages of this type of pasteurizer is that it can be used in conjunction with the regular milk can coolers which most dairymen already have. It is a simple plumbing job to assemble a hot and cold water valve, and connect to a small centrifugal pump. In this manner, both hot and cold water can be pumped through the same line to heat up or cool down the milk. This pasteurizer has an advantage too that it is easily washed and can be kept clean.

In our original experimental work, we soon found that it was necessary to provide an insulation outside cover to the pasteurizer to prevent heat losses. The inside container and top is made of stainless

MILK PASTEURIZATION (Continued)

steel as well as the outlet valve. The outer jacket surrounding the pasteurizer is made of copper, therefore, requires sufficient insulation. In this particular experimental model, we used celotex bound together with gummed label tape, as an insulator.

When this pasteurizer is manufactured for sale, a more durable type of insulation will be provided. The new square type pasteurizer will employ a flood system rather than a spray system, which should make it possible to heat the milk in the tank more quickly as well as cool it more quickly.

MILK REFRIGERATION

1. IDAHO -- Effect of refrigerated storage on milk quality.

This is a CREA project to determine if the quality of milk is greatly affected when stored for 48 to 72 hour periods under proper refrigerated conditions. Detailed information regarding this study was not available at the time of the preparation of this report.

MILKING ELECTRICALLY

1. LOUISIANA -- Louisiana Power & Light Company in cooperation with Louisiana State University Experimental Station at Caljoun, La, made a study on the cost of electricity for milking cows. The following results were obtained:

Cost of Milking Cows With an Electric Milker

<u>Dates</u>	<u>No. Days Used</u>	<u>Electricity Used</u>	<u>No. cows 1 kwhr Milked for 1 day</u>
Feb 22-Mar 22	28 (12 cows)	16 kwhr	21
Mar 22-Apr 21	30 (11 cows)	16 kwhr	21.2
Apr 21-May 20	20 (11 cows)	14 kwhr	22.3

MILKING ELECTRICALLY (Continued)

2.5¢ worth of electricity will milk 21 cows according to results of this study for one day.

The rate for electricity was figured at 2.22¢ which is the average rate paid during the past 12 months.

PANEL HEATING FOR HOMES

1. OHIO -- Ohio Power Company is planning to run tests on Uskon panels manufactured by the U S Rubber Company to determine whether they are economical or suitable to heat a five-room house.

PEANUT DRYING

1. TEXAS -- This project is being conducted under the supervision of Texas A & M College. Electric operating companies serving the state contribute to the funds necessary to carry out the project.

The major problems undertaken in 1948 were: (1) A continuation of the tests to determine the changes in design necessary to adapt the column type grain drier to peanut drying, and (2) Tests with a portable air distribution system.

Special laboratory equipment was designed and built for use in determining the optimum thickness of the column in a column-type drier. A 10" column is recommended for grain drying. Because peanuts are lighter in weight and do not pack together as closely as the smaller grains, it appeared that thicker columns might be used. Tests were made using column thicknesses of 14", 16", and 18". Four different drying air temperatures were used -- 115°, 125°, 135°, and 145° F. The initial moisture content of the peanuts varied from 13.2% to 19.3%. The moisture content after drying varied from 6.4% to 6.8%. The rate of air flow

PEANUT DRYING (Continued)

through the nuts was approximately 100 feet per minute.

The work on the "portable" drier included a series of tests to determine the practicability of a movable air distribution system on which peanuts in sacks could be dried in the field or at any other location around the farmstead. The system used in the tests was a "tunnel" made of heavy welded steel wire mesh. The tunnel was 18 feet long.

The sacks of peanuts were stacked three deep on this tunnel. Tests were made with three different drying air temperatures - 122°, 128°, and 140° F. The rate of air flow through the sacks was approximately 80 feet per minute. The initial moisture content of the peanuts varied from 22.5% to 27.7%. The "end" moisture content averaged 6.5%.

Heated air was supplied to the system by a commercial "package type" heating unit designed for farm drying systems. This unit, mounted on a trailer, contains the fan, power unit, burner, and temperature controls. It is one of some eight or ten similar commercial units now being manufactured.

Samples of the peanuts from each test are being analyzed to determine the effect of the various operating conditions on germination, flavor, shelling characteristics and milling quality.

PIG PRODUCTION

1. INDIANA -- Requirements of electrical radiant heat sources for prevention of baby pig losses. This project is being conducted at Purdue University in cooperation with the USDA. Funds are provided by the Indiana Electric Association and supplemented by state and federal funds.

PIG PRODUCTION (Continued)

The objectives of this project will be (a) to determine the different air temperatures, the optimum energy output required, electrical heating devices, to minimize pig losses, (b) to determine the most practical method of maintaining the optimum energy output required, and (c) to determine the comparative vigor and rate of gain of pigs to weaning as influenced by the above conditions.

The work on this project to date has been devoted to obtaining and building equipment. An insulated 4-pen farrowing house has been built in which the temperature will be controlled by refrigeration and electric heating equipment. The actual experimental work will start the spring farrowing of 1950.

2. INDIANA -- Use of Infra-red heat lamps in pig brooding.

Indianapolis Power & Light Company reports they have worked out a method of prenatal care for sows that has shown very excellent results both in decreasing pig losses and in the rate of gain. A complete report on this activity will appear in the January or February 1950 issue of Electricity on the Farm.

3. WISCONSIN -- At the University of Wisconsin Research Farm, in cooperation with the Wisconsin Utilities Association, they will study the effect of heat produced by soil heating cable embedded in the floors of farrowing pens.

PLANT PROPAGATION

1. INDIANA -- Use of soil heating cable to propagate tomato plants. Indianapolis Power & Light Company cooperated with Ristow greenhouses in this project.

PLANT PROPAGATION (Continued)

2. MISSISSIPPI -- Mississippi Power & Light Company is cooperating with the State Crop Experiment Stations on raising tomato and pepper plants in electrified hot beds. These experiments have been successful and more farmers are installing hot beds for their use. No further details were reported.

3. TEXAS -- These projects were conducted by Texas A & M College and the electric operating companies cooperating.

The unusually cold weather in east and south Texas in the Spring of 1948 killed practically all tomato plants, either in the hot-bed or in the coldframe, because of inadequate facilities for supplying supplemental heat. It was very difficult for growers to secure plants from other areas and the quality of the plants secured was very poor because of disease and the distance transported. Because of the poor quality of replacement plants and the delay in planting, the loss in yield and in price received for tomatoes was severe. The loss in east Texas was estimated at more than \$5,000,000.

One result of this experience was a revival of interest in heating equipment, particularly electric, for hotbeds and cold frames. During January, February and March of this year, the Agricultural Engineering and Horticulture Departments of the College and at least two of the electric service companies in the State, conducted tests or demonstrations with electric soil heating equipment. These tests and demonstrations supplement similar work done by the College and the companies at various times during the past 22 years. The tests conducted this year provide additional information on

1. The advantage of electricity over other sources of heat
2. The cost of electric equipment and the operating costs under present conditions.
3. Improvements in design and methods of operation.

PLANT PROPAGATION (Continued)

Hotbed Tests Near Jacksonville -- During January and February of this year, Mr F C Rand, district manager, Southwestern Electric Service Company at Jacksonville, assisted two plant growers in that area with the design, installation and operation of electric hotbed heating installations, using lamps installed in the air above the plants as a source of heat. 200-watt lamps were suspended in the air approximately 20" above the soil. They were spaced at intervals of 3 feet along the length of the bed. This arrangement provided 200 watts for each 24 sq ft, or approximately 8 watts per sq ft of bed area. The lamps were controlled manually and were turned on and off as the operator felt that heat was needed.

Nick Bruno, a plant grower near Jacksonville, operated hotbeds with a total area of 4,392 sq ft in which he produced a total of 576,000 tomato plants. The seeds were planted January 21 and the first plants were removed on February 23.

The total heating "load" was 38.2 kw and during the 33 days of operation he used 3920 kwhr. The total cost of power was \$73.18, or 12.7¢ per thousand plants.

Mr Bruno was well pleased with the results obtained with the electric heating equipment. The cost of the equipment was comparatively low and it was very simple to install. In spite of the extreme cold weather during the first few days of operation, the seed germinated quickly and the plants grew off rapidly, producing healthy, hardy plants. The operating cost was considered to be very reasonable.

C A Phillips of Bullard used similar hotbeds totaling 1620 sq ft. The total wattage of the lamps for heating was 12 kw. By planting his seed broadcast instead of in 3" rows, as at the Bruno farm, he was

PLANT PROPAGATION (Continued)

able to produce more plants per sq ft of bed area. His total production was 450,000 plants at a power cost of 11.5¢ per thousand. This bed was planted on January 24 and the first plants were removed on the 25th of February -- 32 days later. The same satisfactory results were obtained at this farm as at the Bruno Farm.

Hotbed Tests Near Houston -- During December 1948 and January 1949, Homer Gibbs, head of the farm service department, Houston Lighting and Power Company, and members of his department, conducted a series of tests with plant growers near Houston to compare the operation of electrically heated beds with manure heated beds and with wood-burning, flue-heated beds. A 36 sq ft hotbed was also operated by a member of the department to determine minimum wattage requirements and optimum spacing of electric heating cable in the soil.

Records were kept on the operation of an electrically heated bed on the Albert Baumgartner farm during the period December 12, 1948 to February 2, 1949. The total area of this bed was 180 sq ft. It was used to produce pepper plants. The rate of planting was such that only 75 plants were produced per sq ft of bed. This was done purposely so that the plants could be left in the bed until time for field planting, instead of being transferred into a cold frame for several weeks. Heat was used for frost protection only during the time the plants would normally have been in a cold frame.

The cost of power was approximately \$1.10 per thousand. If the plants had been purchased, they would have cost between \$3 and \$4 per thousand. There was very little damage in the bed from "damping off" and Mr Baumgartner was well pleased with the quality of the plants and the operating cost.

PLANT PROPAGATION (Continued)

Operating records were kept on another electric bed on the farm of Frank Hieden. This installation consisted of six 6' x 50' beds, a total of 1800 sq ft. During the plant growing period beginning December 28, 1948 the beds were used for producing tomato, egg plant, and pepper plants.

The cost of power was approximately 75¢ per thousand plants grown. The average price of "purchased" plants in the area was \$4.00 per thousand.

Mr Hieden stated that the electric beds required less labor, produced better plants, and operated at a lower over-all cost than any other method.

A 5' x 30' manure-heated hotbed was operated on the Edwin Benefer farm. This bed was covered with celoglas. It was used to produce pepper plants.

Because of insufficient heat, and a high incidence of "damping off", approximately 75 per cent of the plants were lost. Only 3000 plants were transferred to the field.

Mr Benefer also had two small manure-heated hotbeds in which he planted tomatoes. All plants from the first seeding in these beds were killed by the cold.

A 3' x 36' flue-type bed was heated with wood on the Ernest Strack farm. Four thousand eight hundred and sixty plants were produced. The flue-heated bed proved unsatisfactory because of uneven growth of the plants, total loss of all plants in an 8 inch strip immediately over the flue, and the labor required for operation.

Jim Blunt, of the commercial department of the company, operated a 36 sq ft hotbed at his home. He used synthetic covered electric cable

PLANT PROPAGATION (Continued)

spaced laterally at 10-inch intervals and 9 inches deep. The total wattage was 200, giving 5.5 watts per sq ft of bed area. This is one-half the amount recommended by the manufacturer.

Minimum temperatures, two inches below the surface of the soil in the hotbed, varied from 48° F to 82° F while outside minimum air temperatures varied from 14° F to 69° F. During a four-day period when minimum outside temperatures averaged 22° F, the average minimum soil temperature in the bed was 54°. The average temperature maintained in the electric bed during the entire period of operation was approximately 68° F. The average use of power was approximately 1.4 kwhr per day per "sash" (18 sq ft) during the period December 7, 1948 to February 5, 1949. The operation of the bed proved very satisfactory even during the unusually cold weather experienced at Houston this winter.

Hotbed Tests at College Station -- On February 1, 1948, students taking a course in "Plant Production" under Professor H C Mohr of the Horticulture Department of the College, planted tomato seed in "flats" in the greenhouse. During the last week in February, the flats containing the plants were transferred to hotbeds covered with glass. Electric heating cable was installed in one of the hotbeds below the flats. The thermostat was set to maintain a temperature of 75°. In the other bed, no supplementary heat was provided.

On March 11 and 12, the atmospheric temperature at College Station dropped to a minimum of 20° F each day. The maximum temperature on the 11th was 38° F, and on the 12th, 44° F. All tomato plants in the unheated bed were killed. Those in the electrically heated bed were undamaged.

On March 15, the plants from the electric bed were planted in

PLANT PROPAGATION (Continued)

the field (minimum temperature on the 15th was 60° F).

Practically all tomato plants for commercial production in the area near College Station are normally produced in unheated beds. As a result of this practice all of the first planting in the area were killed in the spring of 1948. No other tomatoes were available on the local market at the time those on the College farm were ready for harvest. As a result, the price was high and a gross return of \$1000 per acre was realized. This was at least twice the normal return and the increase can be credited almost entirely to the use of supplemental heat in the hotbed. The cost of electricity to heat the bed area to supply plants for one acre of tomatoes was less than \$1.00.

In 1949, Professor Mohr's class again grew tomato plants. This year the seeds were planted on February 4th in flats in the electrically heated hotbeds instead of in the greenhouse, as in the previous year. The heating cable under the flats was spaced laterally to provide 5.7 watts per sq ft of bed area.

The rate of planting was "thin" so that the plants could be "hardened off" in hotbeds without transfer to cold frames. The plants were put in the field on March 25 and 26.

Because of the "thin" planting, only 27 plants were produced per sq ft of bed area. Use of electricity was at the rate of 11.7 kwhr per 1000 plants.

J H Ard, Research Assistant, Agricultural Engineering Department, worked with Professor Mohr and his students in keeping records on the operation of the hotbeds in 1949. He assisted with the installation of the electric cable and regulating the thermostats. He installed a watt-hour meter to measure the amount of electricity used. He also installed

PLANT PROPAGATION (Continued)

and operated recording thermometers in the hotbeds and in the "outside" air.

In the Spring of 1949, Mr Ard assisted Mr G A Buffington, Assistant Horticulturist in charge of the Tomato Investigations Field Laboratory of the Agricultural Experiment Station at Franklin, in keeping records on the operation of electrically heated hotbeds as compared to unheated beds for producing sweet potato plants.

The electric cable in the heated bed was spaced so as to provide 7.5 watts per sq ft of bed area. The thermostat was set to maintain a temperature of 85° F.

The sweet potato seeds were planted in both the heated bed and unheated bed on February 25th. On April 14th, plants were available from the electrically heated bed for field planting. The progress of the plants in the check bed was approximately two weeks behind the electric bed. By April 27th, 136 plants per sq ft had been removed from the electric bed, while only 63 plants per sq ft were obtained from the unheated bed. Additional plants will be available from each bed, but on April 27th the indications were that the electrically heated bed would produce approximately twice as many plants as the unheated.

Heating in the electric bed was discontinued on April 26th. On the basis of estimated total yield of plants it appears that the use of electricity will be approximately 35.4 kwhr per 1000 plants.

From these tests, it appears that in addition to the saving in labor and other advantages of electric operation over other sources of heat, the sweet potato grower might expect to gain in at least three ways by using an electrically heated bed:

PLANT PROPAGATION (Continued)

1. Sweet potato growers estimate that the cost of seed potatoes and bed space (unheated) for producing the plants for 1 acre is \$50.00. With the electric cable, the yield of plants can be doubled-- a saving of approximately \$25.00 per acre in cost of production.

2. Earlier field planting will result in higher yields.

3. Earlier planting means earlier harvest and the price of the first potatoes on the market is usually higher than a few weeks later when harvest reaches the peak.

4. LOUISIANA -- Louisiana Power & Light Company in cooperation with Louisiana State University, made studies of kilowatthour consumption on sweet potato beds under actual farm conditions in 1947 and 1948.

Refer to Louisiana Sheet #1 and Louisiana Sheet #2 for the results of these tests.

STUDIES MADE ON USE OF
ELECTRIC SOIL HEATING CABLE
DURING SPRING OF 1947

	Installation # 1 at Bogalusa		Installation # 2 at Gibsland	
	Insulated Bed	Uninsulated Bed	Insulated Bed Installation	Uninsulated Bed # 2
Size Bed	6' x 6'	6' x 6'	10-1/2' x 32'	10-1/2' x 32'
Area of Bed	36 Sq Ft	36 Sq Ft	346 Sq Ft	346 Sq Ft
Electric Consumption	154 Kwh	220 Kwh	1922 Kwh	1912 Kwh
Electric Consumption Per Sq Ft of Beds	4.3 Kwh	6.1 Kwh	5.56 Kwh	5.53 Kwh
Number Plants Produced	6500	8400	No record	No record
Electric Consumption per 1000 Plants	23.7	26.2	22 Kwh**	22 Kwh
Type Insulation	Pine Straw	None	Sawdust	None
Depth of Insulation	5"	0"	4"	0"
Type Cover Used	Cotton fertil-izer sacks	Cotton fertil-izer sacks	Heavy duck-cloth	Heavy duck-cloth
Materials Used in Construction of Sidewalls	1" x 12" Boards***	1" x 12" Boards	Brick	Brick

All Hotbeds had individual check meters on them.

Potatoes were bedded on March 1st on Installation No. 1. 6 Bushels potatoes were used.

This meter was checked after it was removed and found to be operating properly.

** This figure was arrived at by dividing the figure given us by Mr Fields on the cost of electricity per 1000 plants by his average cost per Kwh.

*** The sides of these Hotbeds were banked with pine straw covered with dirt.

NOTE: We had an unusually cool spring.

ELECTRIC CONSUMPTION ON ELECTRICALLY HEATED SWEET POTATO HOTBEDS
AT FIELD'S AND MERRITT'S, GIBSLAND, LOUISIANA IN 1948

Bed No.	Size of Bed	Amt of Cable Per Bed	Thermo-stat	Insulation	Approx Date Bedded	Date Meter Installed	Date Completed	Kwh Consumption	Bell Telephone Bed-Check
1.	10-1/2 x 32	360'	Yes	Yes	3/8/48	3/10/48	4/21/48	781	60-10
2.	10-1/2 x 32	360'	Yes	No	3/8/48	3/10/48	4/21/48	544	100-55
3.	10-1/2 x 32	360'	Yes	Yes	3/10/48	3/10/48	4/21/48	358	70-15
4.	10-1/2 x 32	360'	Yes	No	3/10/48	3/10/48	4/21/48	812	40-0
5.	10-1/2 x 32	360'	Yes	Yes	3/12/48	3/10/48	4/21/48	716	100-55
6.	10-1/4 x 32	360'	Yes	No	3/12/48	3/10/48	4/21/48	666	100-65
7.	10-1/2 x 60	480'	Yes	Some	3/8/48	3/10/48	4/21/48	555	90-40
8.	10-1/2 x 32	360'	No	No	3/12/48	3/10/48	4/21/48	1024	No Check

Average Consumption Per Sq Ft of Insulated Beds - 1.47 Kwh
Average Consumption Per Sq Ft of Uninsulated Beds - 2.01 Kwh

MR H S HODGE, BOGALUSE, LOUISIANA

6' x 6'	Yes	3/13/48	3/13/48	4/4/48	102	No Check
6' x 6'	Yes	3/13/48	3/13/48	4/4/48	74	No Check

Average Consumption Per Sq Ft of Insulated Bed - 2.9 Kwh
Average Consumption Per Sq Ft of Uninsulated Bed - 2.1 Kwh

POULTRY HOUSE VENTILATION.

1. INDIANA -- Effect of Thermal Insulation on Temperature, Moisture Condition and Ventilation of a Poultry House. This project was conducted at Purdue University in cooperation with USDA. Funds were provided by the Indiana Electric Association and supplemented by state and federal funds.

Observations and measurements were made in February and March of 1947 on the effect of insulation and mechanical ventilation on the temperature and moisture conditions in a 100' x 14' poultry house. The inside walls of the entire house were lined with matched boards. The east one-half of the house was insulated and a partition placed between the end and west one-half. Temperature and relative humidity were measured in each end and outside of the poultry house by recording hygro-thermographs. Three electric brooders and approximately 450 barred plymouth rock broilers were placed in each one-half of the house. The insulated end was equipped with a 10" fan controlled with an electronic humidity controller. For two weeks natural ventilation was used in the insulated end of the poultry house, then a 12" fan was installed and operated continuously for the next four weeks.

For the entire period of the test, February 7 to March 17, the walls and ceiling of the uninsulated end were extremely wet with condensed moisture. Even the 12" ventilating fan operating continuously did not correct this condition. Except for a few extremely cold days when the temperature was below 8° F, the walls and ceiling of the insulated end of the poultry house were dry.

A moisture test of the litter the day before it was changed showed that the insulated portion of the poultry house contained 54% moisture (wet basis) while that of the insulated end had 42%. The average

POULTRY HOUSE VENTILATION (Continued)

relative humidity of the insulated portion of the poultry house was 5% to 10% lower than the uninsulated portion and the average temperature was 10° to 20° higher.

By insulating the walls and ceiling of poultry houses, condensation can be avoided with less ventilation and thus the house is kept warmer.

An article entitled "Airflow in Poultry House Ventilation -- a Theoretical Analysis", was published by L L Sammet and H J Barre in the July 1949 issue of Agriculture Engineering.

2. MAINE -- This project is a cooperative project between the University of Maine and the electric operating companies that serve that state. The object of the study is to determine the optimum amount of air movement necessary to maintain desirable environmental and operational conditions of temperature, humidity, ammonia concentration, and dry litter for broiler houses in Maine.

3. ILLINOIS -- Illinois Northern Utilities Company reports they have a cooperative project in process of completion with the University of Illinois.

4. OHIO -- Ohio Power Company has made a study to determine (a) proper location of fans and ducts (b) amount of air required (c) type of air intakes and location of same. The best results were obtained when amounts of air exceeding 2 cfm per bird were recommended with fans located on the lee side of house and when possible drawing air from under the roofs. They further conclude that where poultry houses are not insulated, the value of winter ventilation is questionable. However, noticeable

POULTRY HOUSE VENTILATION (Continued)

benefits occurred when summer ventilation was installed in such houses.

5. NEW YORK -- The New York State Farm Electrification Council has a continuing project on this subject. The following was reported for 1947:

The electric fan ventilation system for poultry houses was used again this past winter. No detailed data were taken but litter and wall conditions were closely observed. While no labor was required to control any part of the ventilation system and the floor litter was not changed, the moisture conditions were less favorable than during the past two seasons. The litter had to be reconditioned with hydrated lime and stirred more frequently than for other years. The extremely low temperatures during mid-winter may account for this different. The building being so poorly insulated that a larger part of the small amount of heat available from the birds was lost through the side-walls. This left little available heat to dry the litter.

This project has continued through 1948 and 1949. For detailed information contact the New York State Farm Electrification Council at Cornell University.

6. CONNECTICUT -- Windowless poultry houses. The Connecticut Light & Power Company has authorized but not yet started this project in cooperation with a poultry farmer. A three-story brooding and laying house about 200' long without windows will have air conditions controlled by ventilation and all light will be provided artificially. Information on this study will not be available until 1951.

POTATO HOUSE VENTILATION

1. MAINE -- The University of Maine and the electric operating companies that serve the State are cooperating on this project. No details were reported.

POULTRY GROWING

1. MISSISSIPPI -- This project is sponsored by Mississippi Power & Light Company and farm leaders of Tate County 1947 and 1948.

Objective: To prove that poultry is profitable to the farmer as well as the processor. Results:

10 farms grew 15,000 birds.

9 farms showed profit of \$20 to \$140 per thousand

1949 - 30,000 birds are now being grown by farmers

in this county and it is expected that it will reach

50,000 in 1950.

POULTRY HOUSE FLOOR HEATING

1. CALIFORNIA -- Using heating cable. California Electric Power Company reports that they are now making studies in customer's brooder house installations. This study is to get all the pertinent data on 81 kw of heating cable installed in concrete floor for the purpose of brooding chicks. The installation consists of 27 units of 9' x 9' floor space with 3 kw of heating cable in each unit.

2. IDAHO -- Poultry house floor heating -- whether it is necessary, effective, and practical where built up deep litter is used in poultry house laying pens. This is a CREA project. They are using a 60' length of cable (200 watts) embedded one inch in concrete spread

POULTRY HOUSE FLOOR HEATING (Continued)

over an area of 5' x 10'. Alongside this arrangement they have another 60' length built into a portable plywood section 3' x 8'. This allows 8-1/3 watts per square foot compared to 4 watts per square foot in the 5' x 10' area. There is another section of the pen 5' x 10' that has no heat. Comparison of results will be made. This is probably the first experimental work that has been done with floor heating under built-up deep litter.

3. NEW YORK -- The New York State Farm Electrification Council reports the following summary of their work in this field in their progress report for 1948.

1. The use of electric heating cable in the floor of a laying pen with 4 watts per square foot provided a dry litter during this mild winter season.

2. The depth of the litter must be less than 2 inches and it should be of a fine loose texture to permit the birds to work it over for best aeration and thus prevent packing.

3. In this type of house with the day light concentrated in the front, floor heat seems unnecessary in the back half of the floor area.

4. Since the temperature of the floor at the thermostat bulb location rarely went below the thermostat "cut in" setting and the cycling off and on periods were about equal, it appears that 4 watts per square foot was equal to that which might have been necessary with 2 watts and continuous operation. Two watts per square foot on continuous operation was found to be most suitable for Washington State conditions.

POULTRY HOUSE FLOOR HEATING (Continued)

5. The initial cost of the installation of heating cable in addition to the rather high cost of operation throws considerable doubt about its practical application at this stage of the study.

6. Further investigations seem necessary to learn:

- a. Whether a smaller temperature gradient might be obtained with heating cable installed in concrete rather than asphalt.
- b. The best means of controlling the heat or whether continuous heat without control might be most desirable.
- c. What type and depth of litter might be best suited for efficient utilization of the heat in this location.
- d. Whether more insulation under the cable and around the outside edges of the heated slab might reduce the energy consumption materially.
- e. What effect the use of a forced ventilation system might have along with the heat required to keep the litter dry.

4. OREGON -- This is a cooperative project between Oregon State College and the Agricultural Engineering Research Foundation. The budget of the Agricultural Engineering Research Foundation is made up from contributions by the power companies of the State. The purpose of this investigation was to develop equipment and methods of controlling poultry house litter moisture. Three general methods of controlling litter were tried last year -- ventilation, electricity in permanent floor panels and electric heat in portable floor panels. Last year's results showed definite promise as far as all three methods were concerned but further testing will be necessary in order to learn more of the characteristics of each one of these methods. Alterations will need to be made in the ventilation test in order to make the results comparable with the under floor heat.

POULTRY HOUSE FLOOR HEATING (Continued)

5. OREGON -- Radiant floor panel brooding for turkeys. The purpose of this test was to build and test both hot water and electric floor panel brooding systems as compared with the hot air circulation system with wire floors for turkey poults. The results which we obtained last spring indicated that brooding on wire floors resulted in a lower mortality, greater gains in weight and less work. This method of heating was definitely superior to the floor panel brooding.

POULTRY AUTOMATIC WATER SUPPLY

1. NEW YORK -- The New York State Farm Electrification Council reports the following:

Of the five systems used to provide automatic non-freezing water supply in the 20 x 20 Cornell shed roof houses, the "Johnson" cone type waterer in the insulated tile assembly seems most desirable. Fifteen additional waterers were installed in another laying house without tile assemblies but were protected with lead covered heating cable. Some difficulty with overflowing was experienced and it is attributed to a combination of the high concentration of chlorine in the University water supply and the heat from the cable.

The cone type waterer was used successfully as a continuous flow unit with the same resulting dry litter condition around the assembly as that experienced with a similar unit used with automatic flow.

The question still unanswered is regarding the number of birds which can be supplied with one waterer. Future research will determine this.

POULTRY WATER WARMING

1. IDAHO -- This is a CREA project in Idaho. They are studying the use of soil heating cable for this purpose. No further details were reported.

2. IDAHO -- The use of low temperature tape in keeping water warm for chickens. This is a CREA project to determine the cost of de-icing water piping in poultry houses during freezing weather with this new type of heating cable. Detailed information on the results of this project was not available at the writing of this report.

3. WISCONSIN -- At the University of Wisconsin Research Farm in cooperation with the Wisconsin Utilities Association they have a continuing project on the tests of electric heated poultry waterers. Here a special strain of hens were kept in a poultry house where practically all of the windows in the structure were kept open all winter. Result: dry walls, dry ceiling, dry litter, above average laying record, and a healthy flock. The results were excellent but the job of keeping the water from freezing in this poultry house was a strenuous one until a tape type of heating wire was applied to the automatic watering apparatus.

PREVENTING BLUE MOLD ON TOBACCO PLANTS

1. PENNSYLVANIA -- Pennsylvania Power & Light Company reports they are conducting in cooperation with Pennsylvania State College, a project on the use of soil heating cable to prevent blue mold on tobacco plants. No further details were reported.

REFRIGERATION - GENERAL

1. IDAHO -- Practical farm refrigeration. This is a CREA project to determine and tabulate practical standards in selecting or building farm refrigeration units for specialized jobs such as zero freezers, milk coolers, and household units. It is hoped that definite standards can be formulated on the selection of specific refrigeration units for specific jobs on the farm. Further detailed information concerning this project can be obtained from Idaho.

2. MICHIGAN -- The Detroit Edison Company is planning to make a study of the operating cost of all types of farm freezers within the next 12 months.

3. TEXAS -- The refrigeration of perishable products on the farm. The electric operating companies of Texas contributed to the funds necessary to carry out this project.

In the Fall of 1948, a cooperative project was developed through the Texas Agricultural Experiment Station with the Farm Electrification Division, Agricultural Research Administration of the USDA, to conduct a comprehensive research program in the development of designs and specifications for facilities for freezing and storing perishable foods on farms for home consumption and for market.

The first phase selected from this broad field for study was the development of an "all-purpose" or dual-temperature refrigerator designed primarily for cooling, freezing, and storing the farm food supply plus relatively small quantities of products to be sold.

This sub-project is being developed in three stages. First, a survey was made of fifty-five installations of refrigerators of this type now use on Texas farms, ranches, and country estates. The purpose

REFRIGERATION - GENERAL (Continued)

of this survey was to determine the size and dimensions of the storage compartments, the type of construction and the amount of insulation used, the size and type of refrigeration equipment, the amount and kinds of food stored, and other data which would be helpful in establishing specifications for a unit of this type.

The next phase of the study is a survey of 50 to 60 farms in the State where eggs, dressed poultry, vegetables or fruits are produced on a comparatively small scale for market. The objective of this survey is to determine the amount and the kinds of products produced, present method of harvesting or processing, preparation for market, and any losses in quality which might be prevented with properly designed refrigeration equipment. The possibilities for improving existing practices, introducing new methods or expanding markets through the proper use of refrigeration will be discussed with these farm operators and with Extension agents, teachers of vocational agriculture and other agriculture leaders in the areas where the survey is made.

The third phase of the project is the development of specifications for an "all-purpose" refrigerator for farm use under Texas conditions. This will involve:

1. The design and construction of a refrigerator cabinet to provide the chill-room and freezer space indicated in the two farm surveys. The thickness of insulation will be that determined to be most economical under temperature conditions in Texas.
2. Testing the refrigerator under various loading conditions with different types and arrangements of condenser units, evaporators and controls.

The tests will be made in a "constant-temperature" room to be especially constructed for the purpose.

This room will be so constructed that any temperature between

REFRIGERATION - GENERAL (Continued)

20° and 110° F can be maintained. Provision will be made for maintaining constant conditions of relative humidity at any desired level.

The Performance of Farm Freezer Chests -- This project is a cooperative undertaken between the Agriculture Engineering Department of the College, the farm service departments of the electric service companies in Texas, and selected farmers.

The purpose is to study the operation of farm freezer chests under farm conditions in Texas to determine:

- a. Cost of operation
- b. Kind and quantity of products stored
- c. Size of freezer best suited to farm operation
- d. Mechanical performance of units
- e. Quality of products removed
- f. Other operating characteristics

The tests are continued for a minimum of twelve consecutive months at each farm.

Operating records are now being collected from more than sixty farms representing the various types, such as dairy, poultry, livestock and ranches. They are well distributed over the state geographically - from Marshall to San Angelo, from Plainview to Beaumont, and from Wichita Falls to San Beniot. With few exceptions, the operator resides on the farm and the major source of income is from agricultural operations.

The farms are served by the following companies:

Central Power and Light
Gulf States Utilities
Houston Lighting and Power
Southwestern Gas and Electric
Southwestern Public Service
Texas Electric Service
Texas Power and Light
West Texas Utilities

The farm service and local representatives of these companies were responsible for installing the submeters and are taking monthly

REFRIGERATION - GENERAL (Continued)

readings. They have also assisted the farmers in keeping records of the kinds and amounts of food stored.

An analysis of the monthly use of electricity by the farm freezers at nineteen of the test farms from which twelve-month records are complete shows the following:

<u>Size Cu.Ft.</u>	<u>No. Units</u>	<u>Average Use of Electricity (kwhr)</u>	
		<u>Per Month</u>	<u>Per Mo. Per Cu. Ft.</u>
6	3	47	7.8
8	3	66	8.3
12	3	77	6.4
15	2	92	6.1
16*	2	120	7.5
18	4	97	5.4
25	1	172	6.9
30	1	177	5.9
14	19	91	6.5

When these tests are complete the information will be of value to farm service representatives of the electric companies, county Extension agents, vocational teachers, dealers, and others who are called upon to assist the farmer in the selection and use of freezing equipment. It will be helpful to the College for teaching purposes and will be of value to manufacturers in determining future designs and merchandising methods.

REMODELING OF FARM BUILDINGS

1. WISCONSIN -- A project being conducted at the University of Wisconsin Research Farm in cooperation with the Wisconsin Utilities Association.

It is beginning to be clear now that our efforts of the past twenty-five years or more to urge the farmer to use more electricity and use it more efficiently brought scant results because the buildings themselves were not planned for such mechanization and their relation

REMODELING OF FARM BUILDINGS (Continued)

to one another by location generally operated as a barrier to mechanization. As an example, Duffee and Finerson found that a dairy barn equipped with a mechanical barn cleaner would need to be only 32 feet wide. The standard width of Wisconsin and possibly other dairy barns heretofore was from 37 to 40 feet. The reduced construction costs for the thousands of dairy barns which are constructed yearly, if the conclusion that narrower barns are feasible is heeded, would on a national scale be an economic boon to agriculture.

Wisconsin reports further that they have worked out a new design of a narrow dairy barn with the use of an electric barn cleaner.

Currently they are making studies in dairy barn design to include the feeding and handling of young and dry stock in a loose run barn.

REMOVAL OF ICE AND SNOW WITH THE USE OF LEAD COVERED CABLE

1. PENNSYLVANIA -- The Philadelphia Electric Company is making a continuing study on the effectiveness of the removal of ice and snow from a macadam driveway with lead covered cable embedded one-half inch from the top. They want to determine the watts per square foot necessary. No further details reported.

RICE DRYING

1. CALIFORNIA -- A CREA project. A continuing project is reported on the study of heat absorption of infra-red energy, effect of rice temperature on head rice yield, mechanics of drying installations, economics of infra-red drying, and the reliability of moisture tests.

RICE DRYING (Continued)

2. TEXAS -- The tests are being made by Texas A & M College. The electric operating companies serving this state are contributing to the funds necessary to carry out this project.

These 1948 tests were a continuation of those made in 1947 to determine the effect of drying air temperature and initial moisture content of the grain on germination, milling quality, rate of drying, and operating cost. A summary of the work done in 1947 was given in the 1948 Progress Report to the Committee and in Texas Agricultural Experiment Station Progress Report No. 1138, "Drying Rice in Sacks."

Milling and germination tests are now being made on the samples of the grain dried in 1948. When these tests have been completed and the data analyzed, a report will be issued by the Experiment Station.

RICE GROWING

1. MISSISSIPPI -- This project is sponsored by the Washington County Coordinating Council and Mississippi Power & Light Company.

Objective: Compare rice grown in Washington County with rice grown in the rice growing districts in Arkansas.

Results: 500 acres grown in 1948. Average yield per acre 65 bushels compared with Arkansas yield of approximately 52.6 bushels.

5,000 acres planted in 1949, excellent indications of large yield. Project to be continued in 1950.

SOIL PASTEURIZATION

1. INDIANA -- Pasteurization of greenhouse soils with infra-red radiation. This project will be conducted at Purdue University in cooperation with the USDA. Funds will be provided by the Indiana Electric Association and supplemented by state and federal funds. The objectives of this project will be (a) to determine the time required to raise greenhouse soils of various thicknesses and moisture contents to the pasteurization temperature, (b) to develop economical equipment which will suitably expose the soil to infra-red energy.

STOCK TANK WATER WARMING

1. IDAHO -- Use of infra-red lamp to prevent freezing of large stock water tank. This is a CREA project to determine if heat lamps are practical and economical to prevent large water tanks from freezing during cold weather. Complete information was not available concerning this project at the time this report was prepared.

2. IDAHO -- Comparative costs of operating stock tank warmers. This is a CREA project in Idaho to determine which of the three types (floating, immersion, and infra-red lamp) of stock tank warmers are the most effective and economical. Detailed information concerning the results of this project can be obtained from Idaho. Idaho further reports a project on the use of infra-red lamps as an aid in keeping ice from animal drinking fountains.

3. NEW YORK -- The New York Farm Electrification Council has made a study of two units to determine operating characteristics. The results are as follows:

STOCK TANK WATER WARMING (Continued)

The kilowatthour consumption was approximately seven for each day during January which shows that they operated almost continuously during this period. At no time, however, was the ice found completely frozen over in the watering trough. Their use saved many hours of labor formerly required to chop the ice and remove it from the troughs before the cattle could drink.

This test was run in 1947. The Council will continue to investigate this application.

4. TEXAS -- Texas A & M College has conducted this investigation. The electric operating companies of Texas contributed to the funds necessary to carry out this project.

Interest in equipment for heating drinking water for dairy cattle is increasing very rapidly among Texas dairymen. During periods of cold weather, there is usually a serious drop in milk production. Since milk is approximately 87% water, it appears likely that much of this drop in production is due to the cattle refusing to drink cold water.

For the past two years; farm service representatives of the Houston Lighting and Power Company have collected records from, and made observations on the operation of, two installations of this equipment on dairy farms near Houston.

At the F. L. Tucker dairy an immersion type electric heater was used in a metal water trough of 187 gallon capacity to heat drinking water for 100 cows, 80 of which were producing milk. The trough was open at the top and the sides and the bottom were uninsulated. The heater thermostat was set at 70° but the wattage of the heater was sufficient to maintain a temperature of only 55°.

STOCK WATER TANK WARMING (Continued)

Mr Tucker estimated that his milk production during January and February was 51.2 pounds greater than it would have been without the water heater. He was receiving \$6.85 per 100 pounds for his milk. Therefore, his daily gross income was increased \$3.51. The cost of electricity to operate the heater was 30¢ per day, leaving a net increase of \$3.21 per day or almost \$200.00 for the two-month period. The first cost of the heater was approximately \$50.00. The total amount of electricity used for stock tank heating at the Tucker Dairy for the two-month period was 885 kwhr.

At the C L Timmerman dairy, electric equipment was used to heat the water in a 37 gallon cement trough for 180 cows, 60 of which were in milk production.

Mr Timmerman estimated his milk production was increased 43 pounds of milk per day by heating the water.

At \$6.86 per 100 pounds of milk this amounted to \$2.94 increase in the daily gross income. The cost of electricity at 2¢ per kwhr was 27¢ daily, leaving a net increase of \$2.67 per day. The total increase in income for the 80-day period during which the test was conducted was \$213.60. The cost of the heater was approximately \$50.00. The total amount of electricity used at the Timmerman Dairy by the heater was 1081 kwhr during the 80-day period.

From these tests, it appears that the electric stock water heater may be a profitable piece of equipment for both the dairyman and the power supplier.

TOBACCO CURING (Ventilation)

1. CONNECTICUT -- The Connecticut Light & Power Company is now conducting a project in cooperation with the farm electrification research division of USDA, electrical equipment manufacturers, and distributors, to develop an improved method of curing Connecticut broad leaf tobacco (and possibly shade grown). Controlled air distribution is being employed. Data will not be available until 1951.

2. PENNSYLVANIA -- Pennsylvania Power & Light Company reports a project on the ventilation of tobacco curing houses in cooperation with Pennsylvania State College. No details were reported.

TREATMENT OF HAY

1. CALIFORNIA -- Alfalfa leaf shatter is one of the basic problems arising in studies of barn mow hay drying. It has been the purpose of this experiment to submit samples of alfalfa of varying moisture content to a standardized treatment and to measure the shatter losses resulting from said treatment using the resulting data to indicate critical moisture contents for handling hay. This study also includes the determination of protein and carotene losses resulting from varying amounts of leaf shatter. This is a CREA project now being conducted but not completed.

2. INDIANA -- Investigation of the Carotene Destroying System in Alfalfa by Treatment of Plant Tissue and Heat Energy. This project is being conducted at Purdue University in cooperation with USDA. Funds are provided by the Indiana Electric Association and supplemented by state and federal funds.

TREATMENT OF HAY (Continued)

This project was initiated in the summer of 1947 to explore the possibilities of inactivating the carotene destroying system in alfalfa with selected energy treatments, and to determine the stability of carotene in the hay exposed to selected energy treatment during the periods of subsequent field curing and storage. It was found that electrical conduction and ultra violet light were ineffective, infra-red radiation only partially effective, while conduction heating with electrical plates and open-flame heating were effective in destroying the enzyme activity with temperatures above 80° C. The present plans are to use an open flame on the hay and mow cure a quantity large enough to run a feeding trial.

VEGETABLE PROCESSING

1. MISSISSIPPI -- This project is sponsored by Mississippi Power & Light Company, Mississippi Extension Service, Mississippi Experiment Stations, Mississippi Agricultural and Industrial Board, and G S Suppiger Company of St Louis, Missouri.

Objective: To prove that Mississippi vegetables will process of equal quality to the vegetable growing sections of Indiana and Illinois.

Results: According to commercial analysis of the G S Suppiger Company, Mississippi vegetables especially tomatoes will process of the quality products comparable to other vegetable areas. This project is still being continued.

G E N E R A L

Specialized Projects as reported by Puget Sound Power & Light Company - WASHINGTON.

Experimental Laboratory Projects Conducted in 1947.

1. Designed and tested positive temperature alarm system for pressurized room heating units for sounding alarm and shutting off the power in case of failure of the air blower.
2. Improved electric eye bulb counter to accomplish automatic separation of flowering bulbs or other units to be counted in numbers of 100, 250, 500 or 1,000.
3. Ran tests for Spruce Veneer Company as to the feasibility of using a specialized application of infra-red heat for drying laminated wood sheets without warping.
4. Continued our experimental work on poultry litter loosener designed for aerating poultry litter.
5. Designed and built a holly spinner for drying dipped holly.
6. Built a utility belt conveyor for handling dirt, bulbs, potatoes, grain and other products.
7. Designed and built a special drier for a local company manufacturing deorderizing units to be used in refrigerators.
8. Cooperated with the Western Washington Experiment Station in designing heating equipment for drying dipped bulbs.

Designs and Drawings - 1947.

9. Pressurized room heating for ten different plants.
10. Drier for Pur-O-Dor Company.
11. Heating and drying dipped bulbs (Western Washington Experiment Station).

Designs and Drawings (Continued)

12. Special heating units for 15 pressurized brooder rooms for large poultrymen.

13. Centrifuge for drying dipped holly.

14. Utility belt elevator.

15. Litter loosener for stirring deep litter.

16. Series of drawings of the electric eye bulb counter.

17. New improved electric hot bed for cold frame.

Experimental Laboratory Activities for 1948

18. Redesigned litter stirrer and had it tested by a number of leading poultrymen.

19. Prepared and tested several portable floor brooders using pumice stone, metal and wood with negative results.

20. Developed a plan for large flour mill of Seattle for heating rollers with high temperature glow-bar units to replace gas.

21. Built and tested evaporative egg cooler using metal cabinet and forced air in conjunction with moisture.

22. Built entirely new bulb counter using larger rolls and two relays permitting larger selection of numbers for specified operation.

23. Designed a one flat hot bed.

Experimental Laboratory Projects for the First Seven Months of 1949

24. Cornell Egg Washing Machine -- continuation of this project and experimentation is continuing in hopes of meeting the requirements of the Farmers Cooperative.

25. Temperature control of bulb treating tanks. This work was started at the request of the USDA and Dr Charles Gould of the Western Washington Experiment Station. A small pilot tank in our laboratory and several types of thermostats were tested, but as this is precision work the temperature must be controlled to within less than 1

Experimental Laboratory Projects for the First Seven Months of 1949

degree. The bulbs are damaged by too much heat and are not sterilized if the temperature is too low.

26. Designed and built a small electric spray pump for small gardens and home orchards.

27. Designed and supervised installation of large pressurized heating and refrigerating system for a bulb grower.

28. Designed a machine for dipping holly wreaths.

29. Designed a cleaner for washing blueberries.

30. Designed two electric heating and control bulb sterilizing tanks for customers.

Projected Projects

31. Removing foreign material from hay.

32. High pressure systems for cleaning poultry houses.

33. Knock down radiant type brooder that can be easily assembled.

34. Method for removing poultry litter.

35. Cornell Egg Washer improvement and adaptation of hot water supply.

36. Trap for horned owls.

37. Trap for rabbits.

